KMG Kliniken
Akutversorgung
Rehabilitation
Seniorenpflege

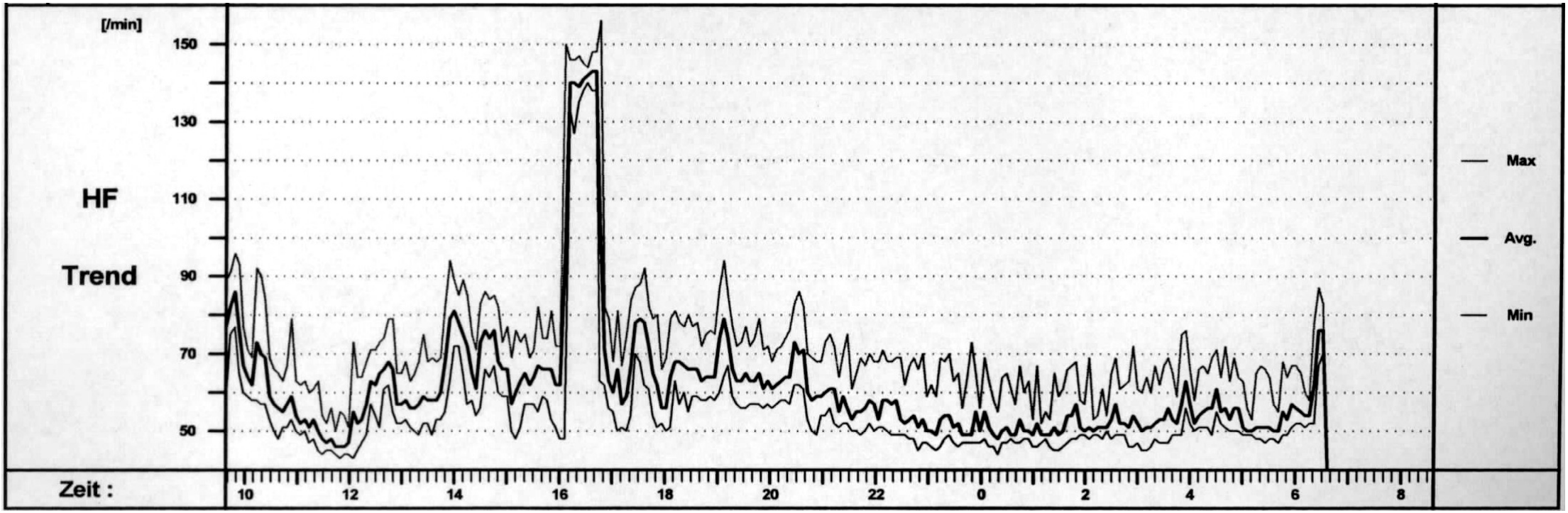
Interventionelle Elektrophysiologie

Leistungsspektrum

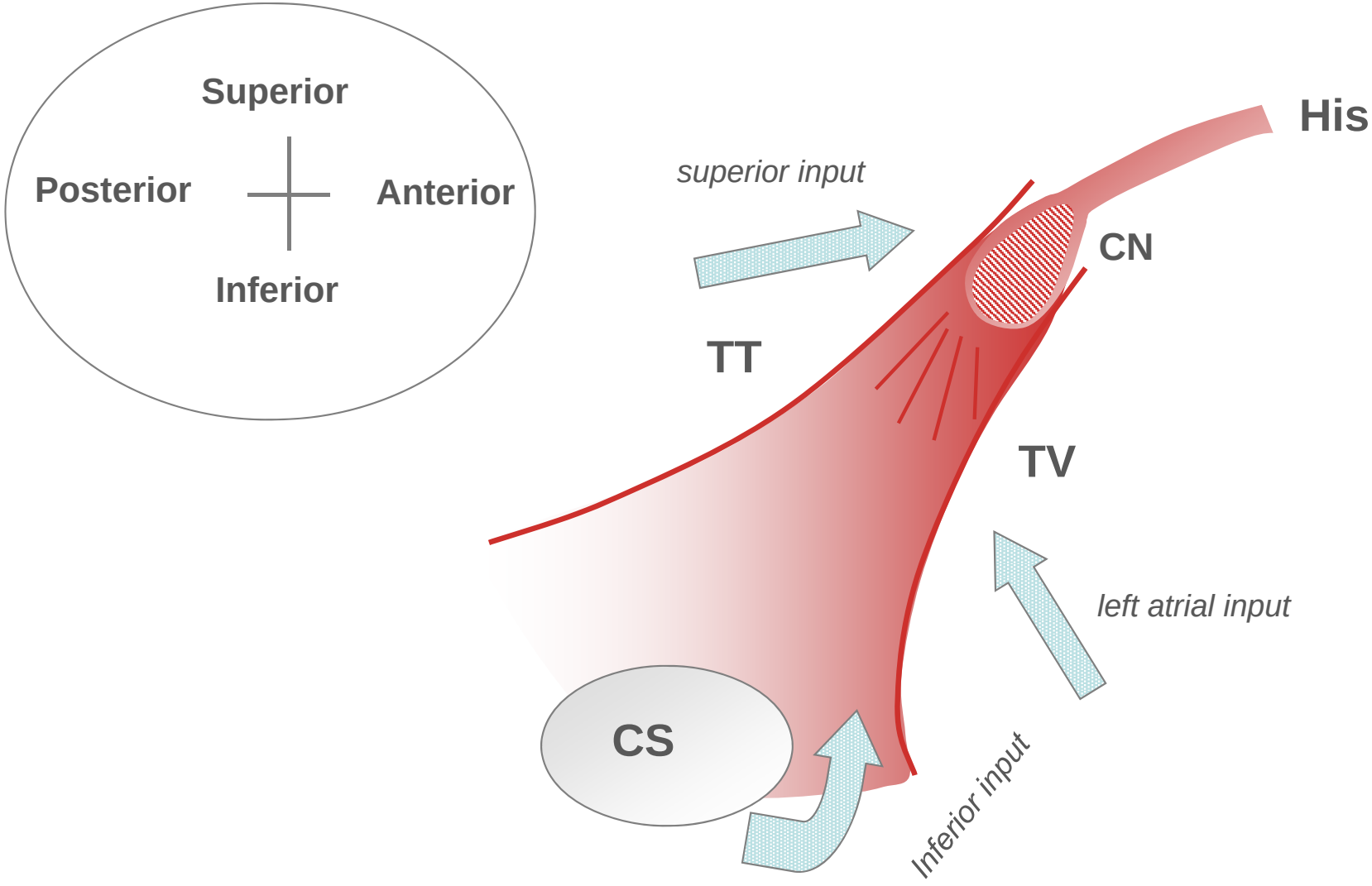
Dietmar Bänsch

Übersicht

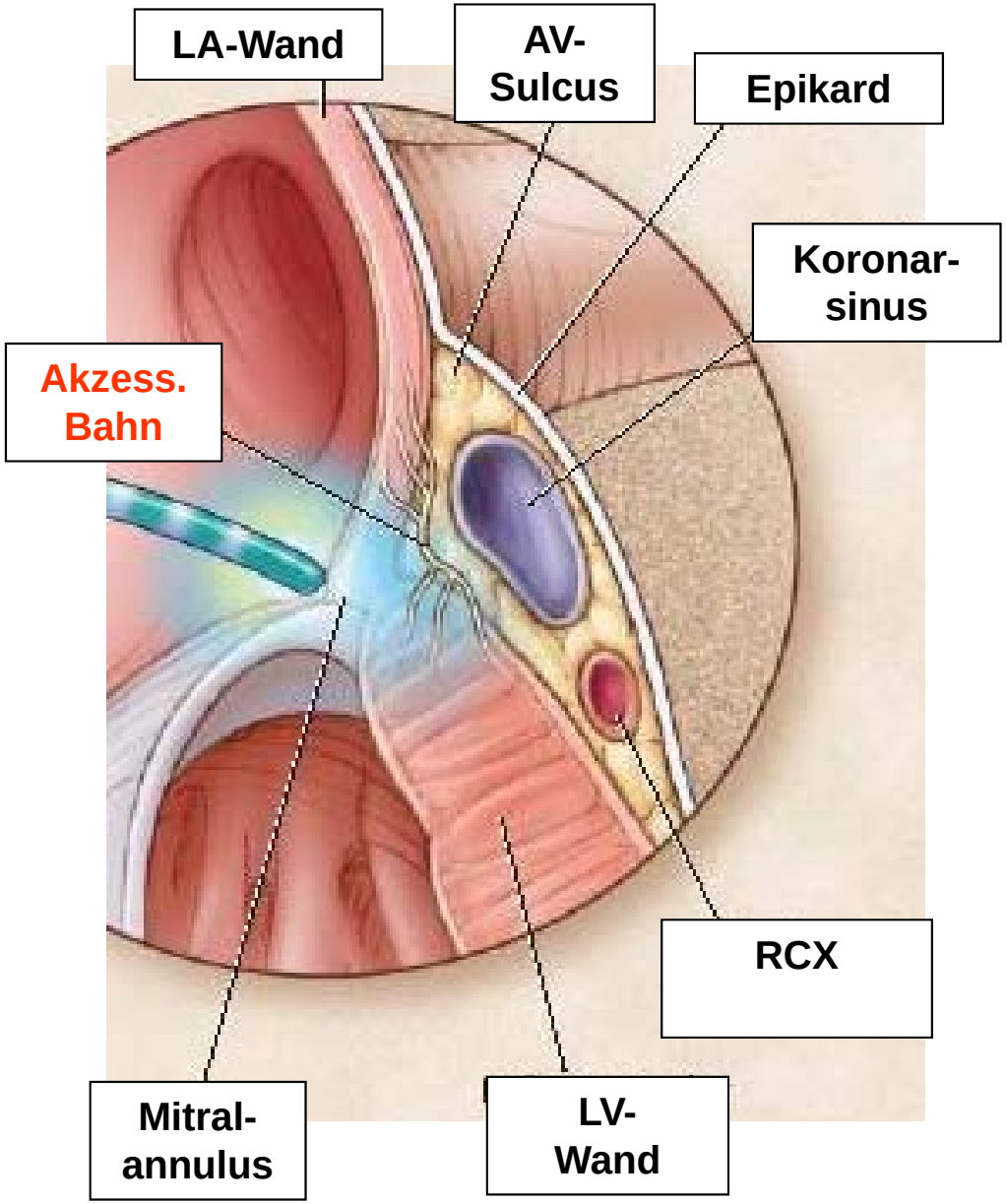
- **Paroxysmales Herzrasen ohne Dokumentation**
- **SVT mit Dokumentation**
  - EAT
  - AVNRT
  - AVRT/ WPW
- **Vorhofflattern**
- **Andere atriale Makro-Reentry-Tachykardien**
- **Vorhofflimmern**
- **Ventrikuläre Tachykardien ohne strukturelle Herzerkrankung**
- **Ventrikuläre Tachykardien mit struktureller Herzerkrankung**
- **Kammerflimmern**

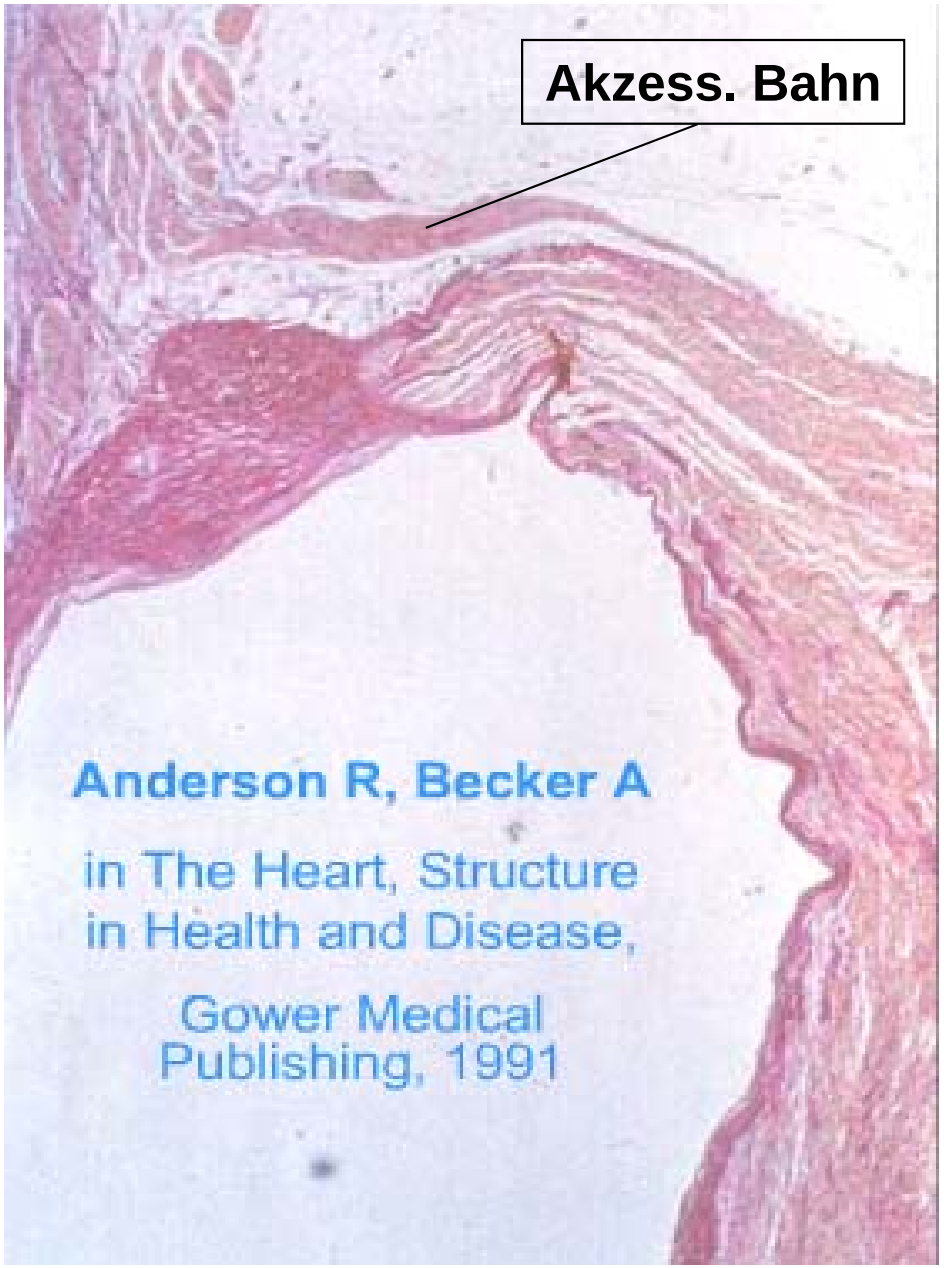

[/min]
150
130
110
90
70
50
HF
Trend
Max
Avg.
Min
Zeit :
10
12
14
16
18
20
22
0
2
4
6
8

AVNRT: Kochsches Dreieck



Akzessorische Leitungsbahn





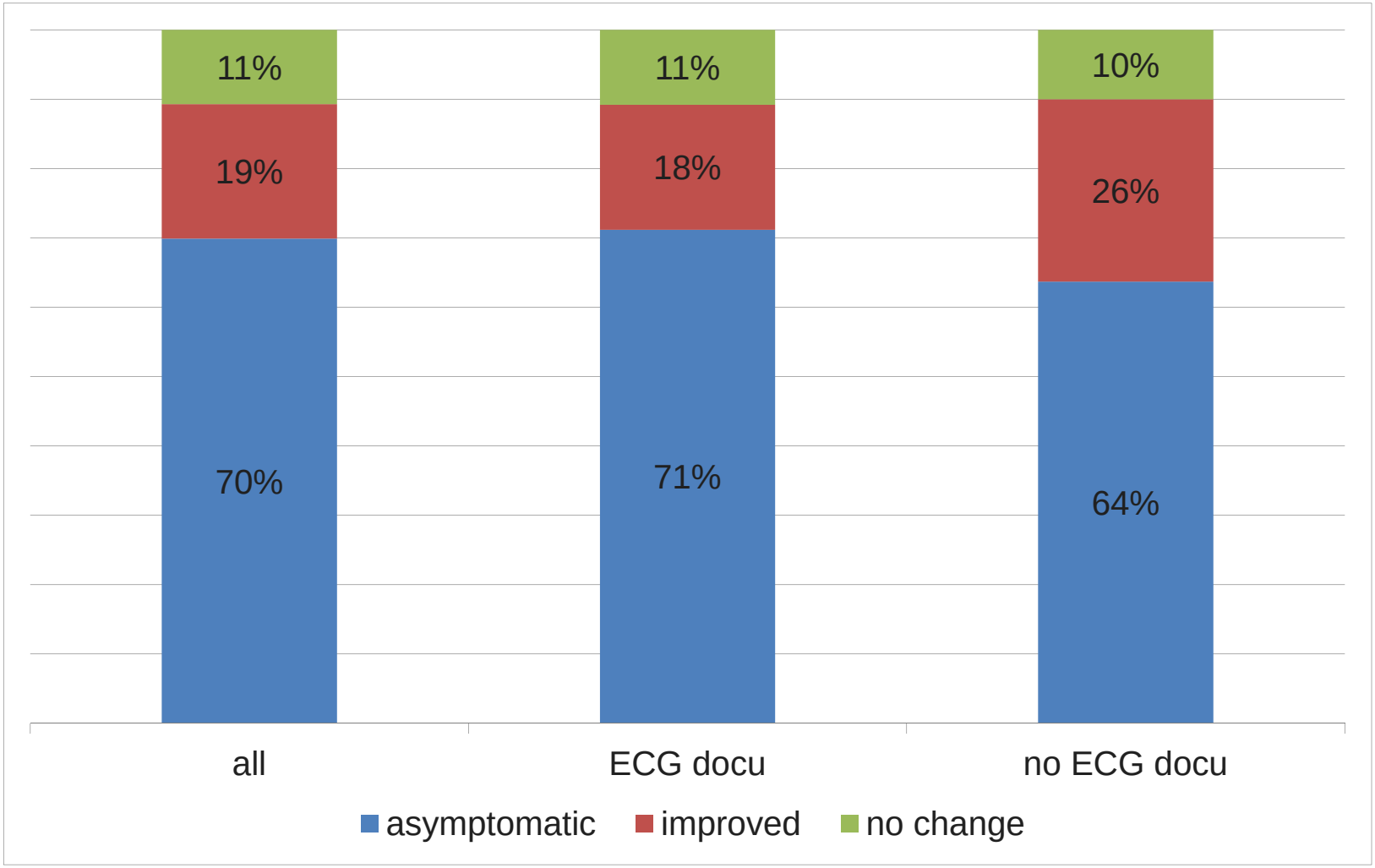
Paroxysmales Herzrasen - Keine Dokumentation

Induzierte SVT

	All (n=525)	ECG documentation (n=423)	No ECG documentation (n=102)
AVNRT	306 (58.3%)	249 (58.9%)	57 (55.9%)
AVRT	89 (17.0%)	87 (20.6%)	2 (2.0%)
AT	33 (6.3%)	28 (6.6%)	5 (4.9%)
AFlut	12 (2.3%)	12 (2.8%)	0
AFib	3 (0.6%)	2 (0.5%)	1 (1.0%)
none	82 (15.6%)	45 (10.6%)	37 (36.2%)

Significantly different distribution between patients with and without ECG documentation ($p < 0.05$)
AT: focal atrial tachycardia, AFlut: Atrial flutter, AFib: Atrial fibrillation.

Paroxysmales Herzrasen - Keine Dokumentation



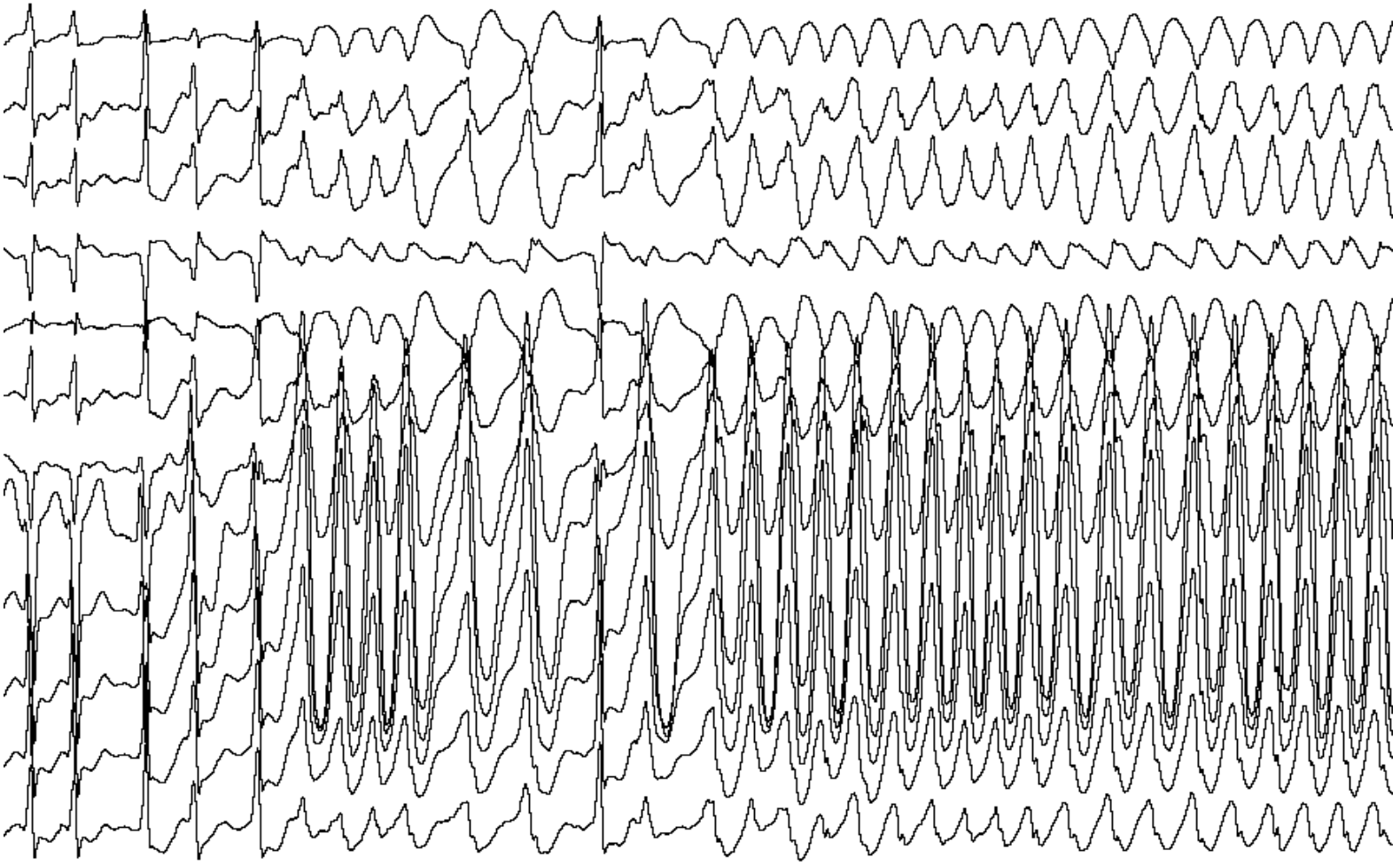
SVT mit oder/ ohne Dokumentation

Indikation

- **“offene Leitungsbahn”,**
  - WPW: Präexzitation + paroxysmale Tachykardien
  - Präexzitationssyndrom: Präexzitation ohne Tachykardien

Gefährliche Supraventrikuläre Rhythmusstörungen

WPW-Syndrom



SVT mit oder/ ohne Dokumentation

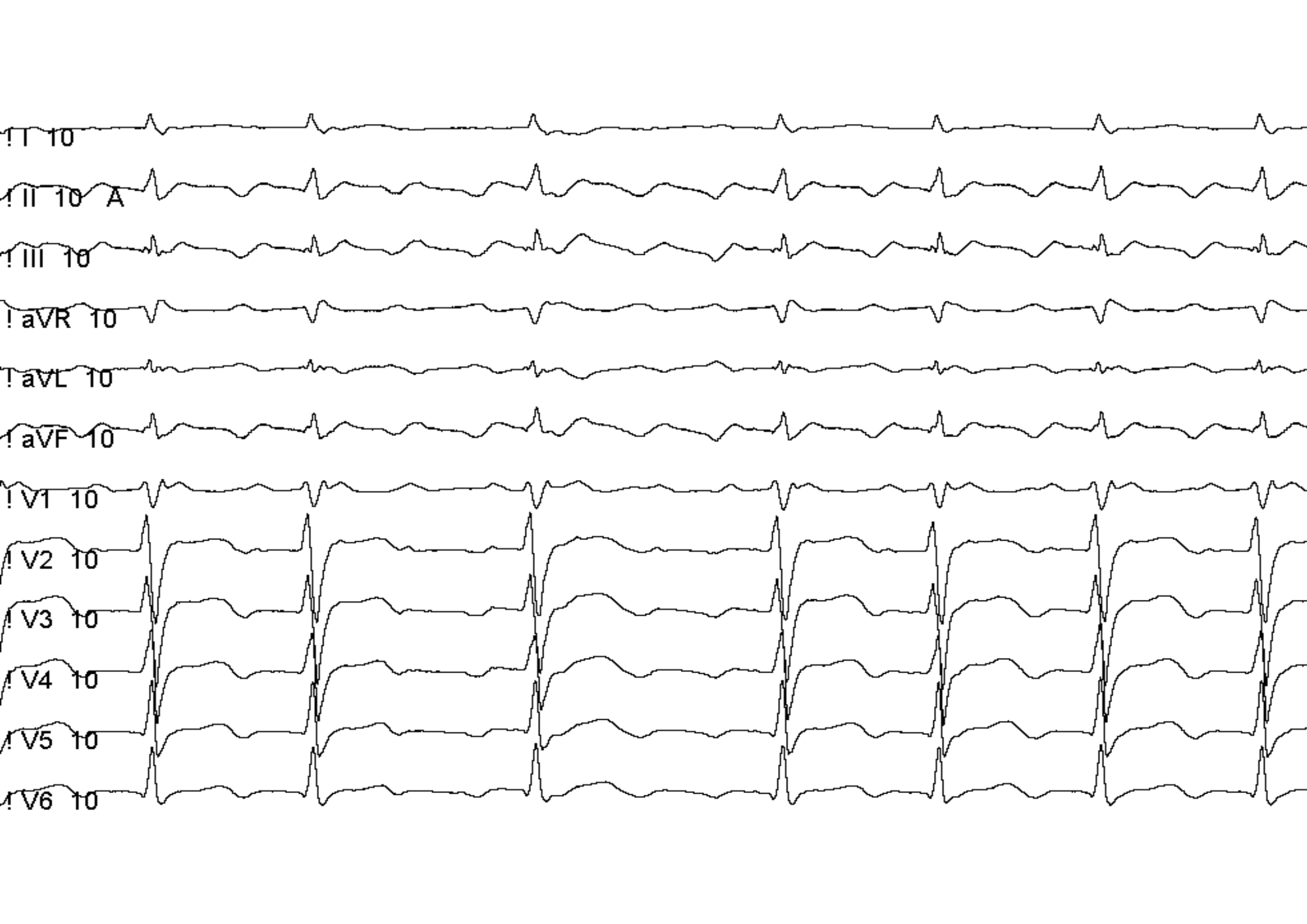
Prozedurvorbereitung

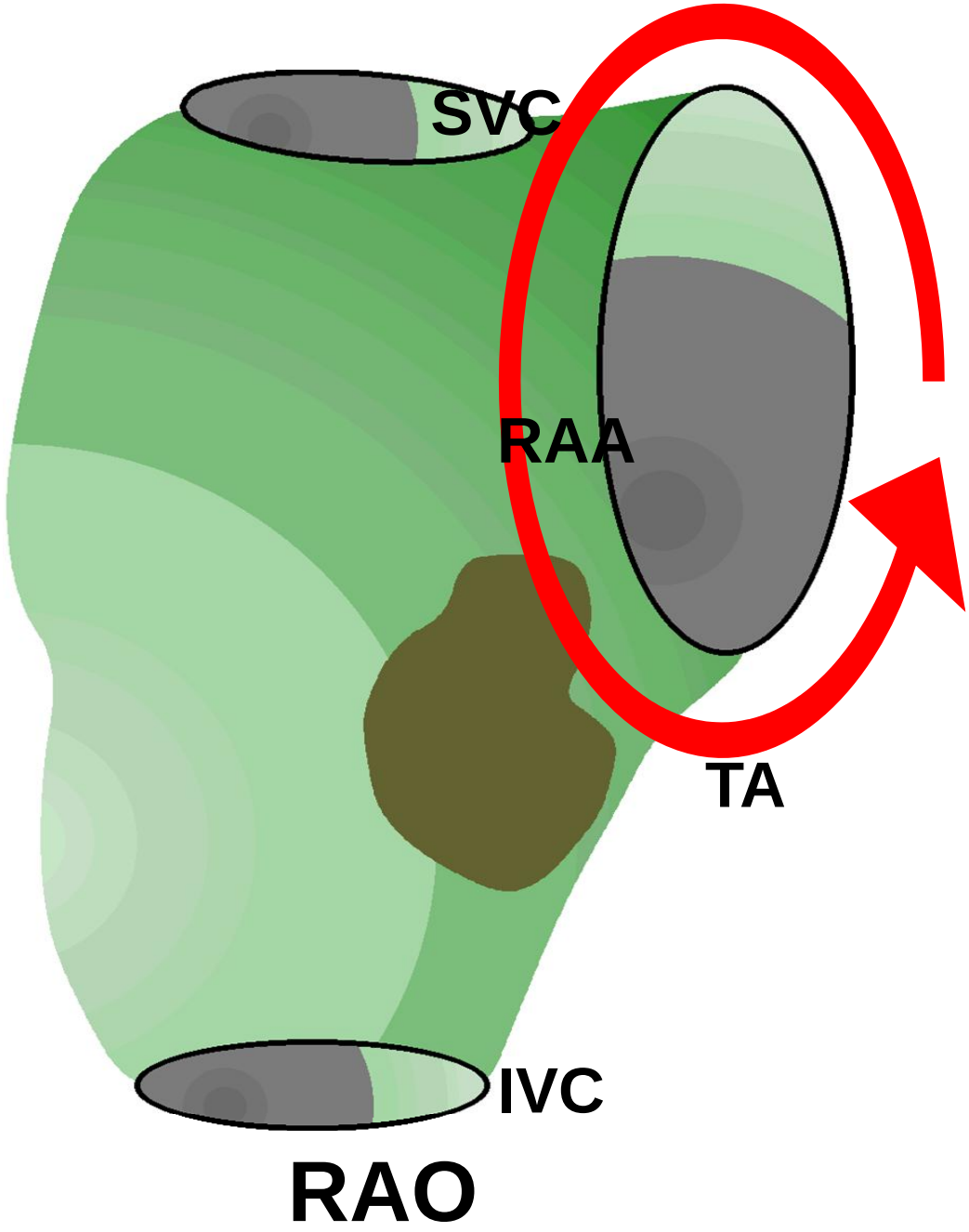
- **Transthorakales Echo: LV, Vitien?**
  - Bei AVRT Ebstein, persistierende obere Hohlvene?
- **EKG-Dokumentation**
- **Betablocker und AA absetzen (4 HWZ)**
- **Antikoagulation mit Vit. K-Antagonisten aus anderen Gründen fortsetzen (INR 2.0-2.5)**
- **NOAK einen Tag vor Prozedur absetzen, je nach Nierenfunktion**

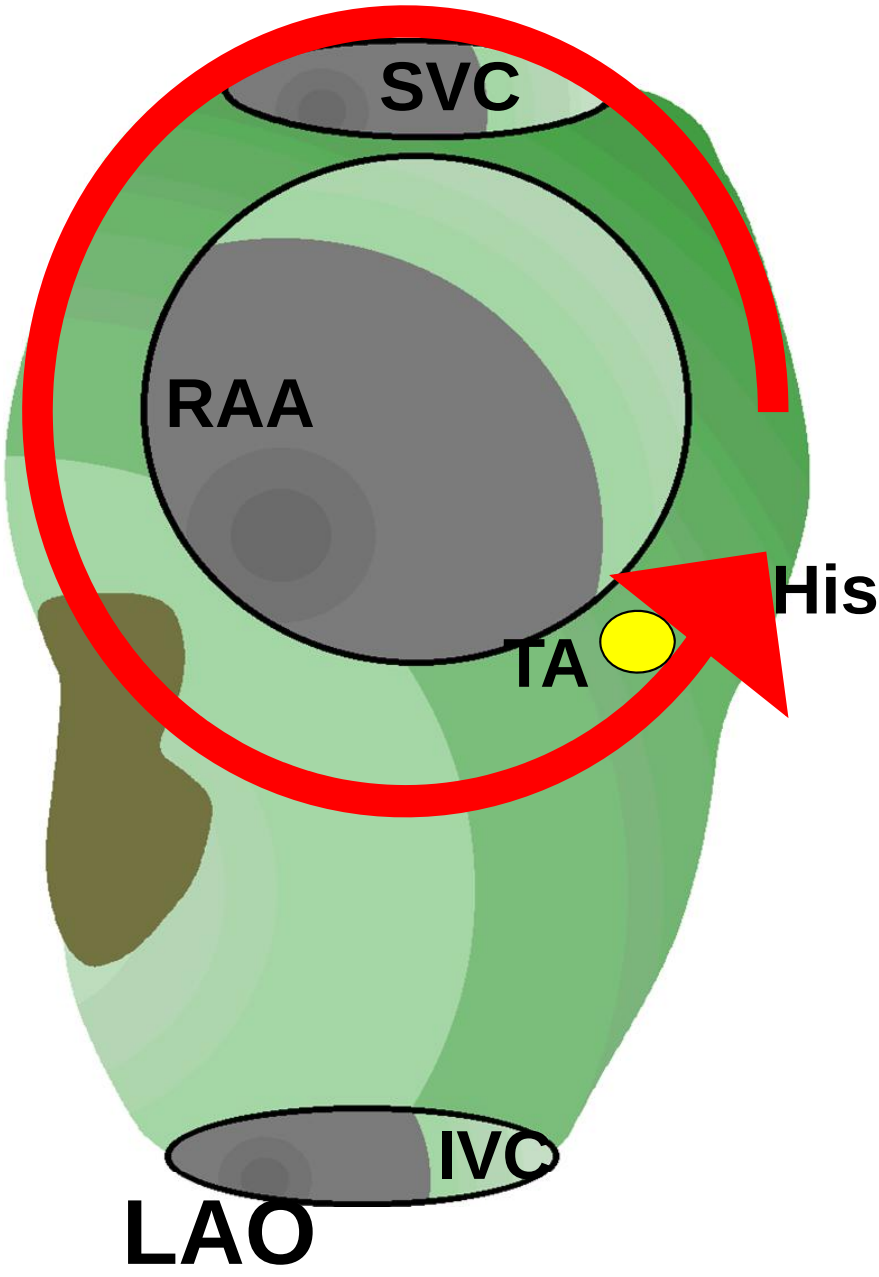
„Gewöhnliches“ Vorhofflattern

Indikation

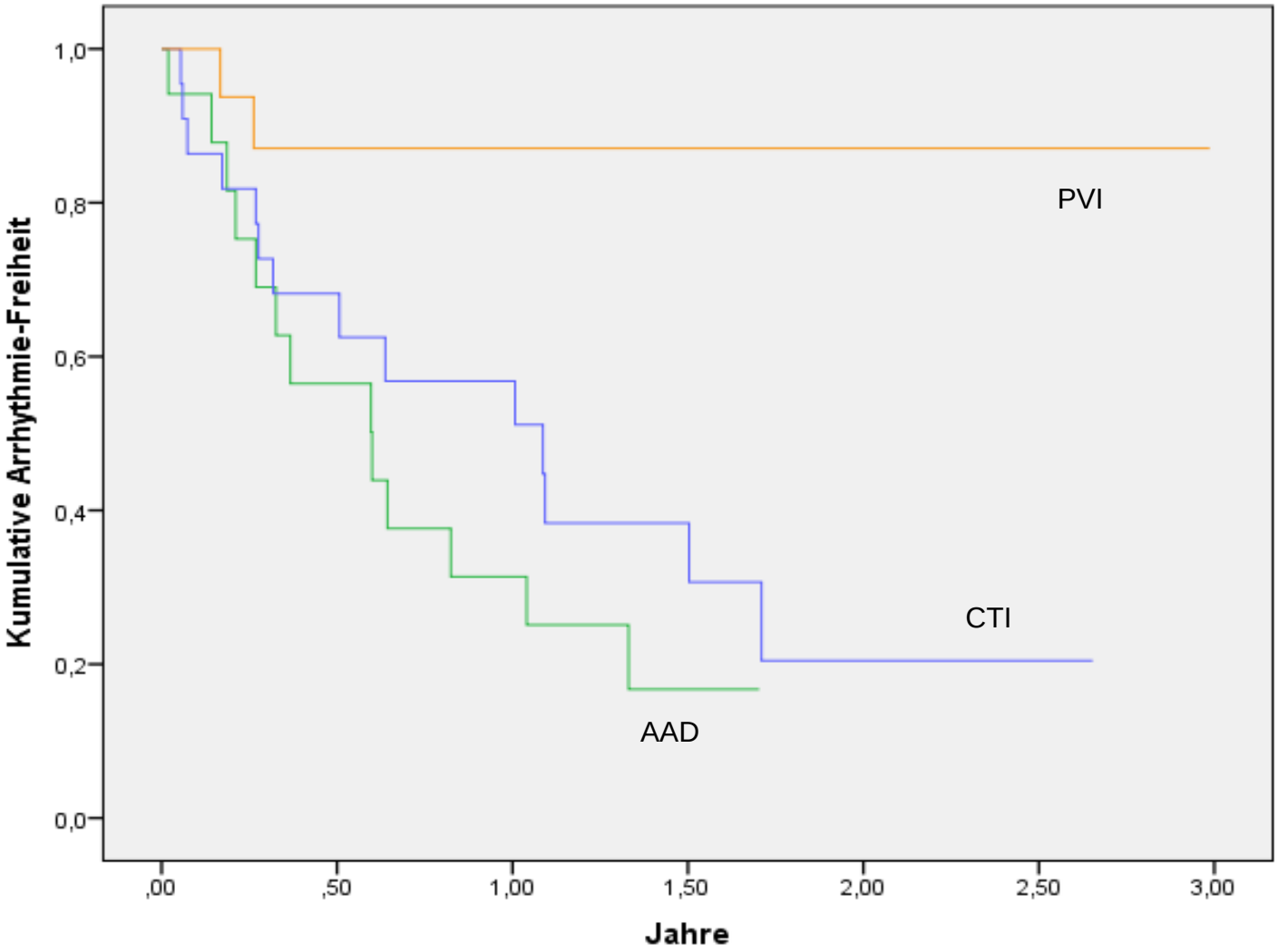
- **Elektiv nach erstem Ereignis,**
  - da Rezidivrate > 60% unter AA
  - 95% ohne AA
- **Fast immer Vorhofflimmern koexistent!**


I 10
II 10 A
III 10
aVR 10
aVL 10
aVF 10
V1 10
V2 10
V3 10
V4 10
V5 10
V6 10


SVC
RAA
TA
IVC
RAO


SVC
RAA
His
TA
IVC
LAO

Atrial Arrhythmia after Ablation



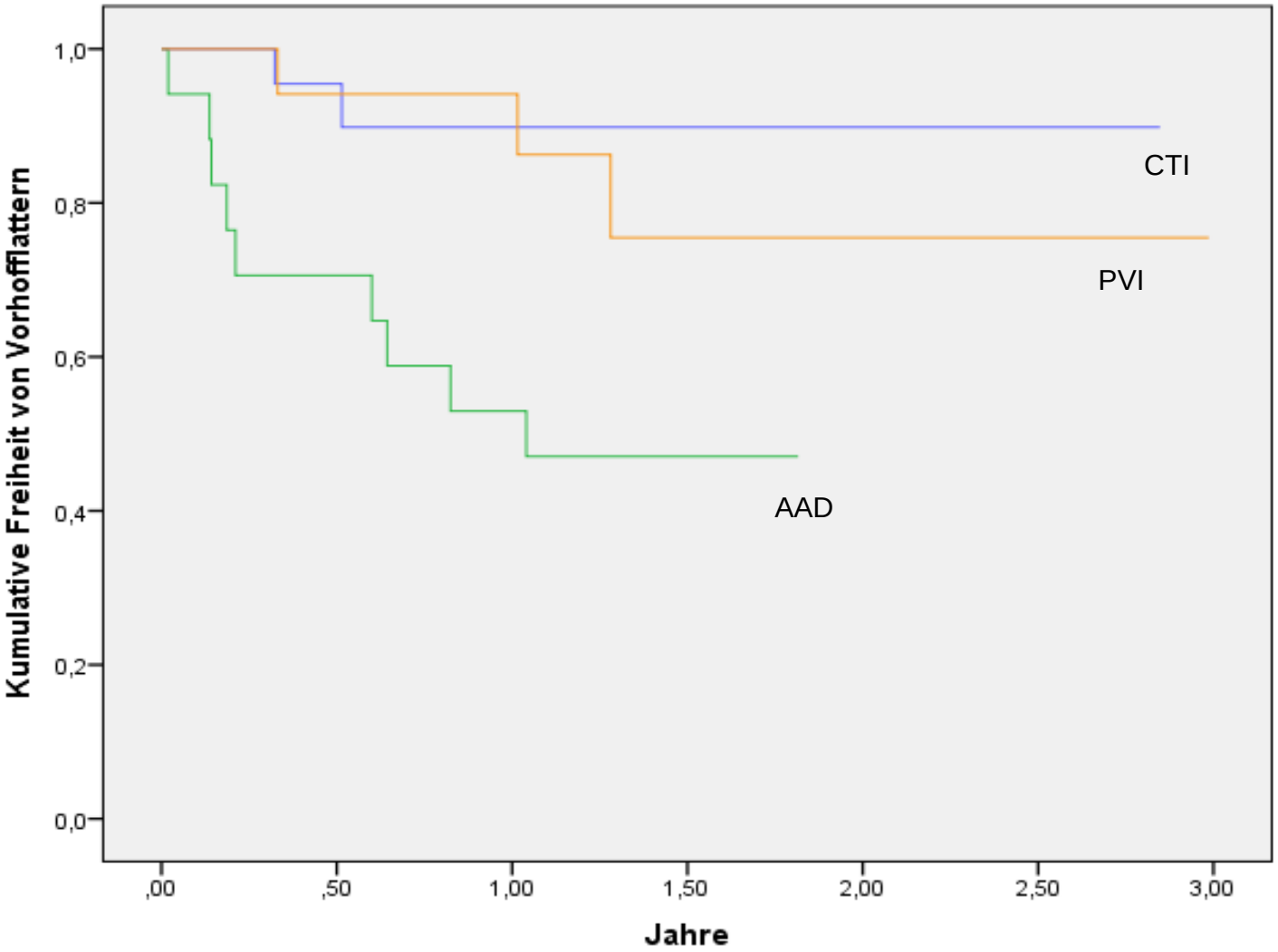
Recurrent Arrhythmia

AAD	14 / 17 (82,3%)
CTI	14 / 23 (60,8%)
PVI	2 /20 (10%)

Pairwise Comparison

AAD vs. PVI	p = 0,001
AAD vs. CTI	p = 0,256
PVI vs. CTI	p = 0,005

Rezidiv von Vorhofflattern



Rezidive Absolut

AAD	9 von 17 (52,9%)
CTI	2 von 23 (8,7%)
PVI	3 von 20 (15,0%)

Paarweise Vergleiche

AAD vs. PVI	p = 0,034
AAD vs. CTI	p = 0,005
PVI vs. CTI	p = 0,520

„Gewöhnliches“ Vorhofflattern

Prozedurvorbereitung

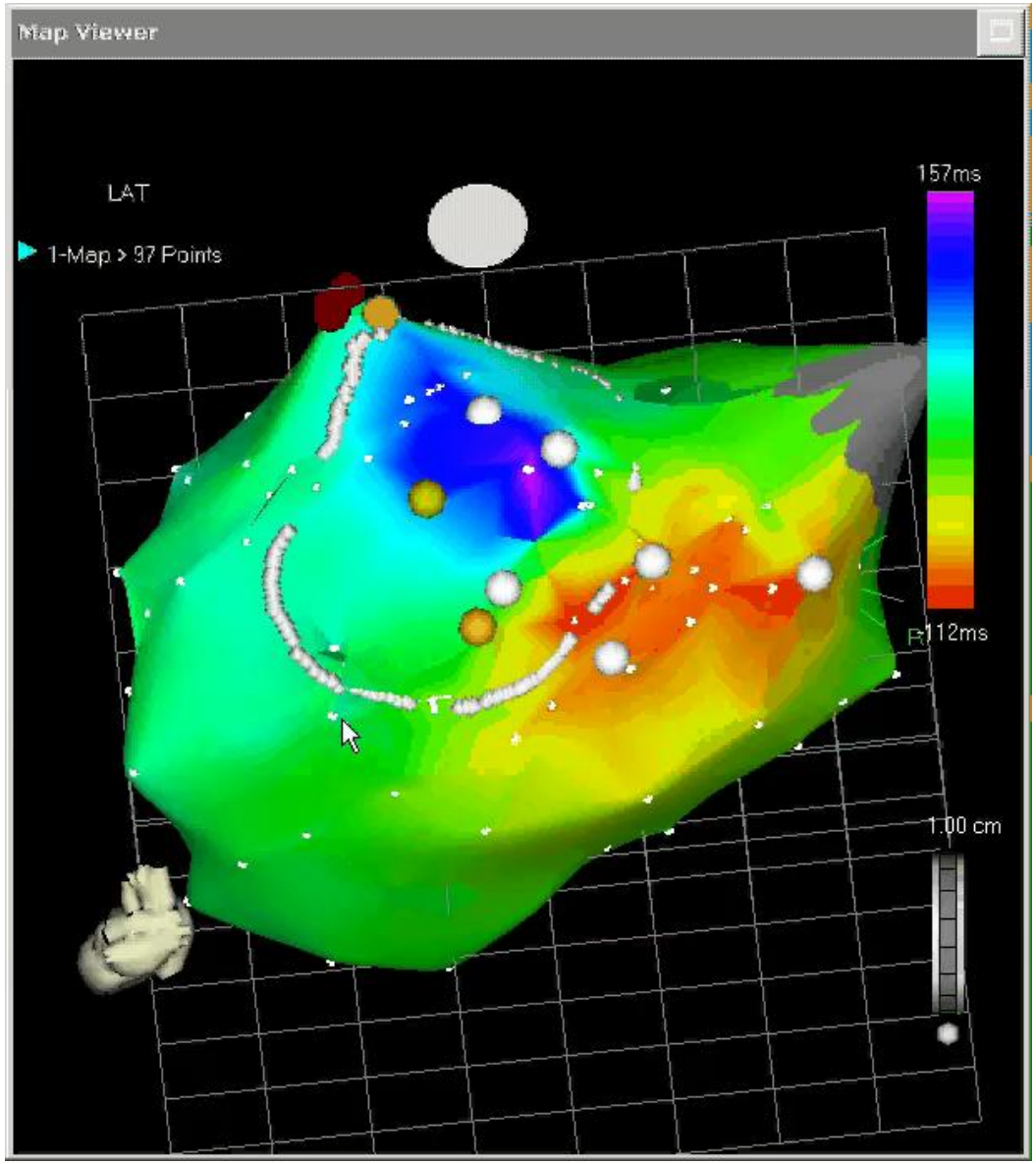
- TEE Antikoagulation
- Kardioversion immer unter AA (Rezidivquote)
- Frequenzkontrolle
- Kurzfristige Vorstellung möglichst im Sinusrhythmus bei hoher Rezidivrate
- Vorhofflimmern häufig koexistent (Auslöser)
- TEE vor Ablation, wenn Patient im Vorhofflattern
- Keine TEE, wenn im Sinusrhythmus!!!
- Antikoagulation wie bei Vorhofflimmern/ Loop Recorder bei niedrigem CHADs-Score

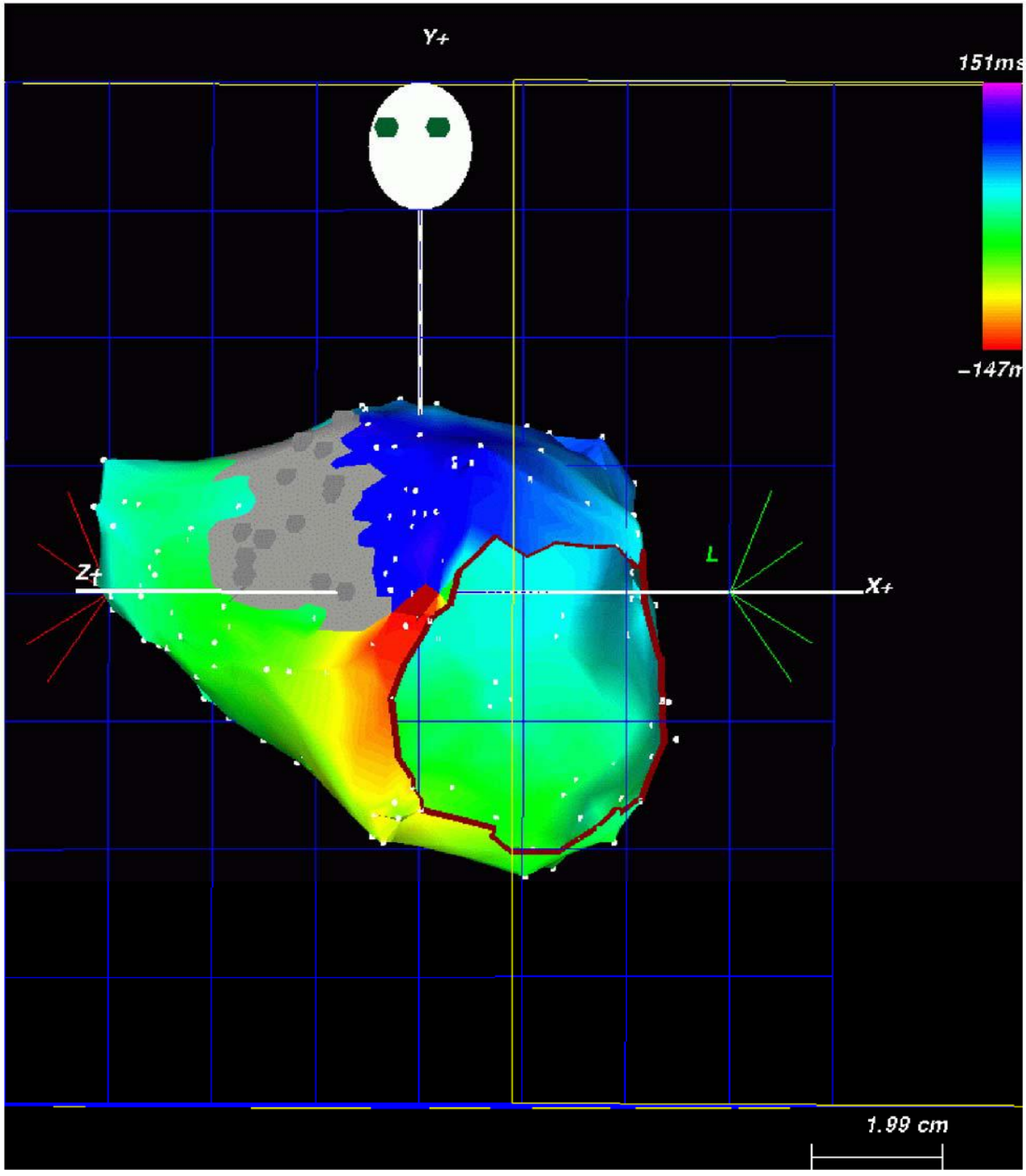
„Ungewöhnliches“ Vorhofflattern

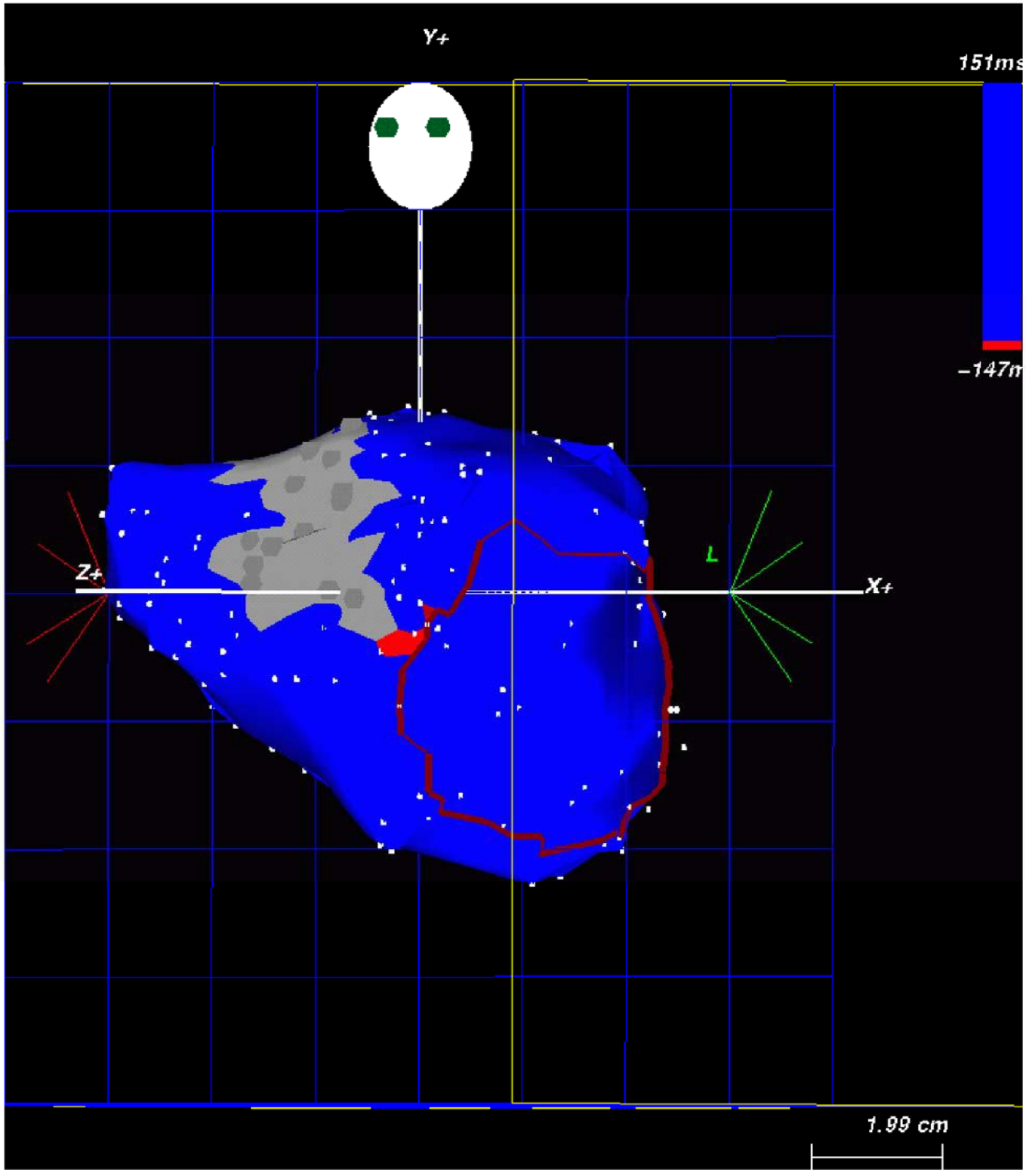
Indikation

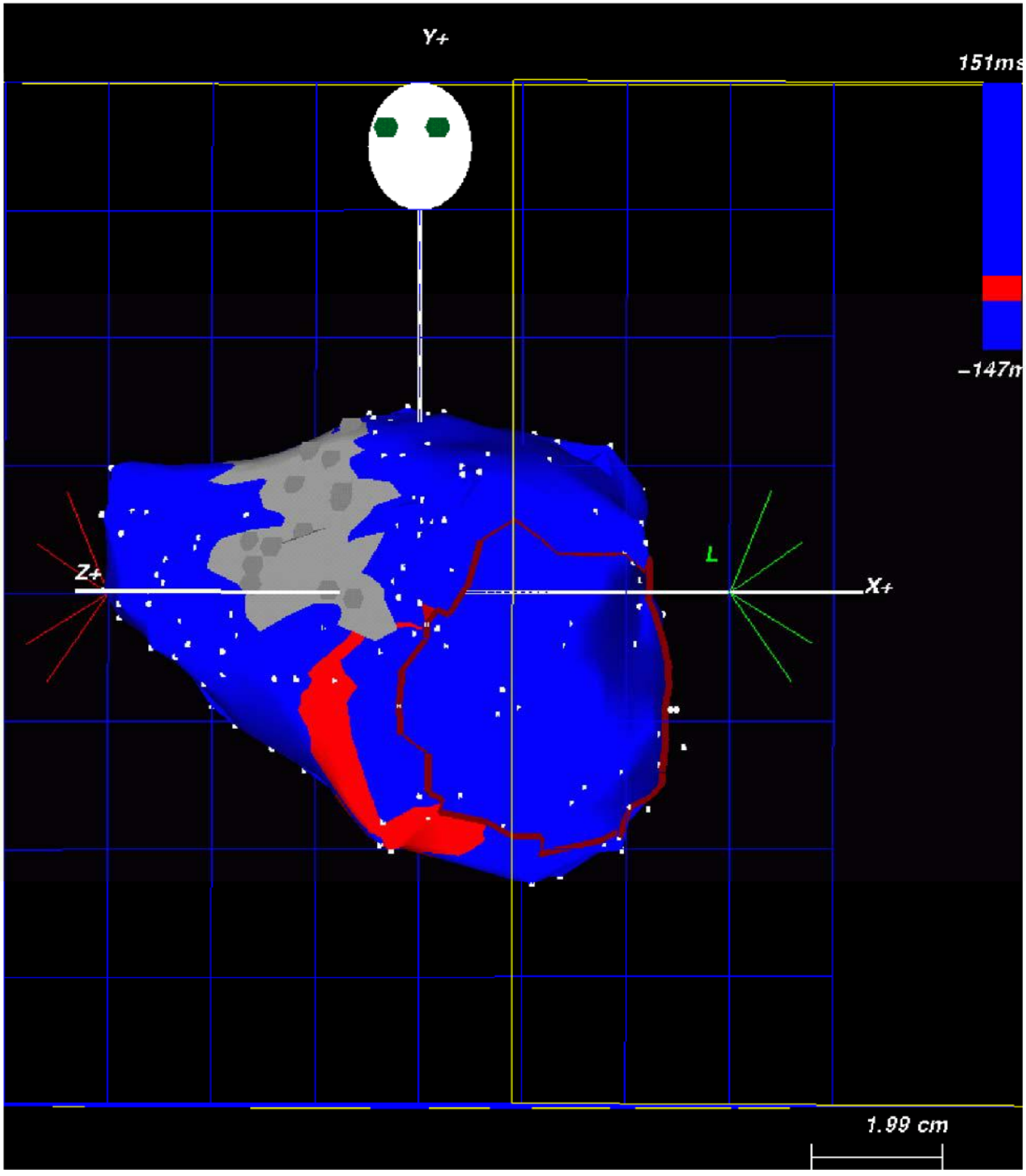
- **Immer, da oft langsam und 1:1-Überleitung möglich**
- **Ablation am besten in der Tachykardie, da schwer induzierbar**

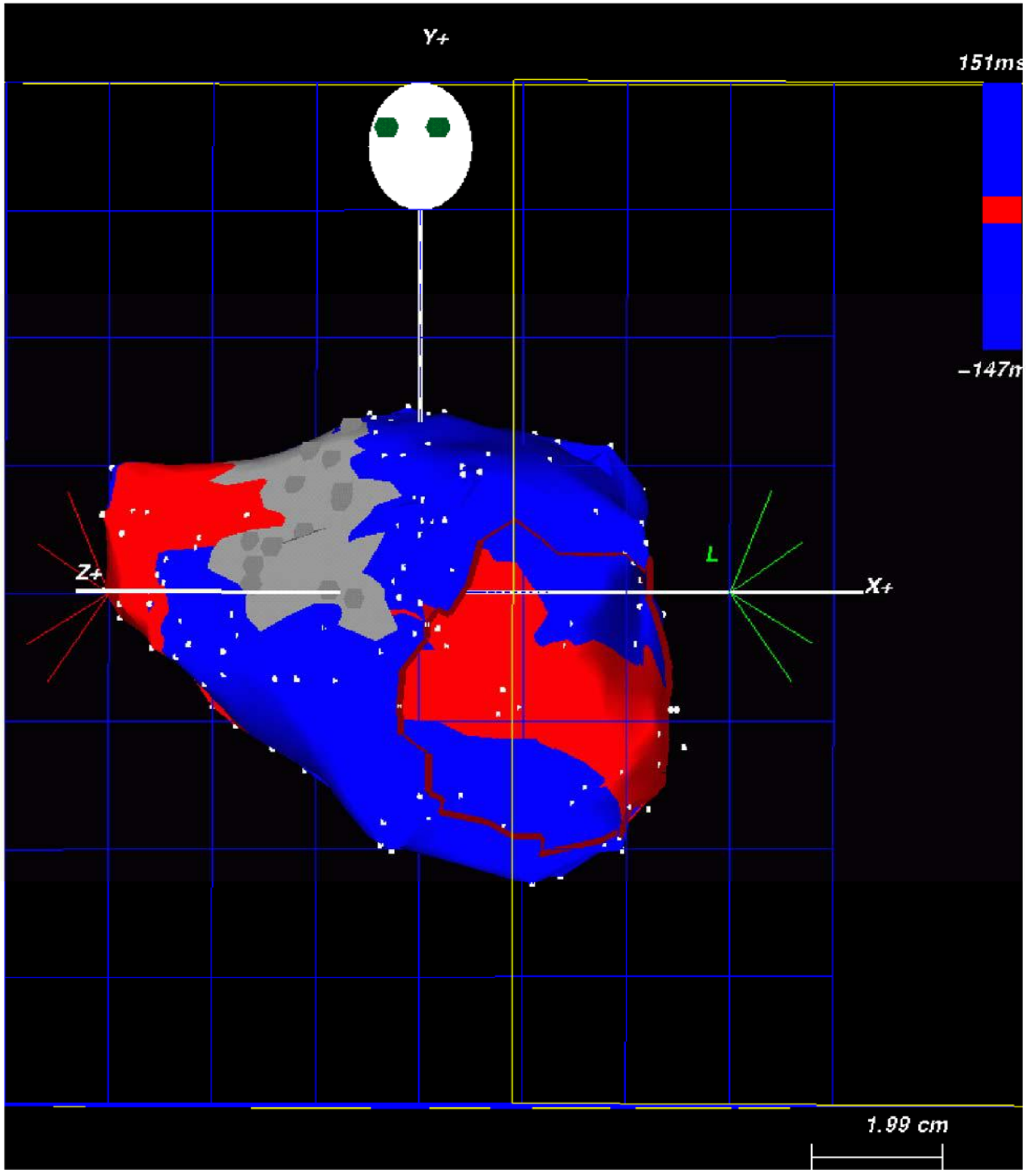
Pulmonalvenentachykardie

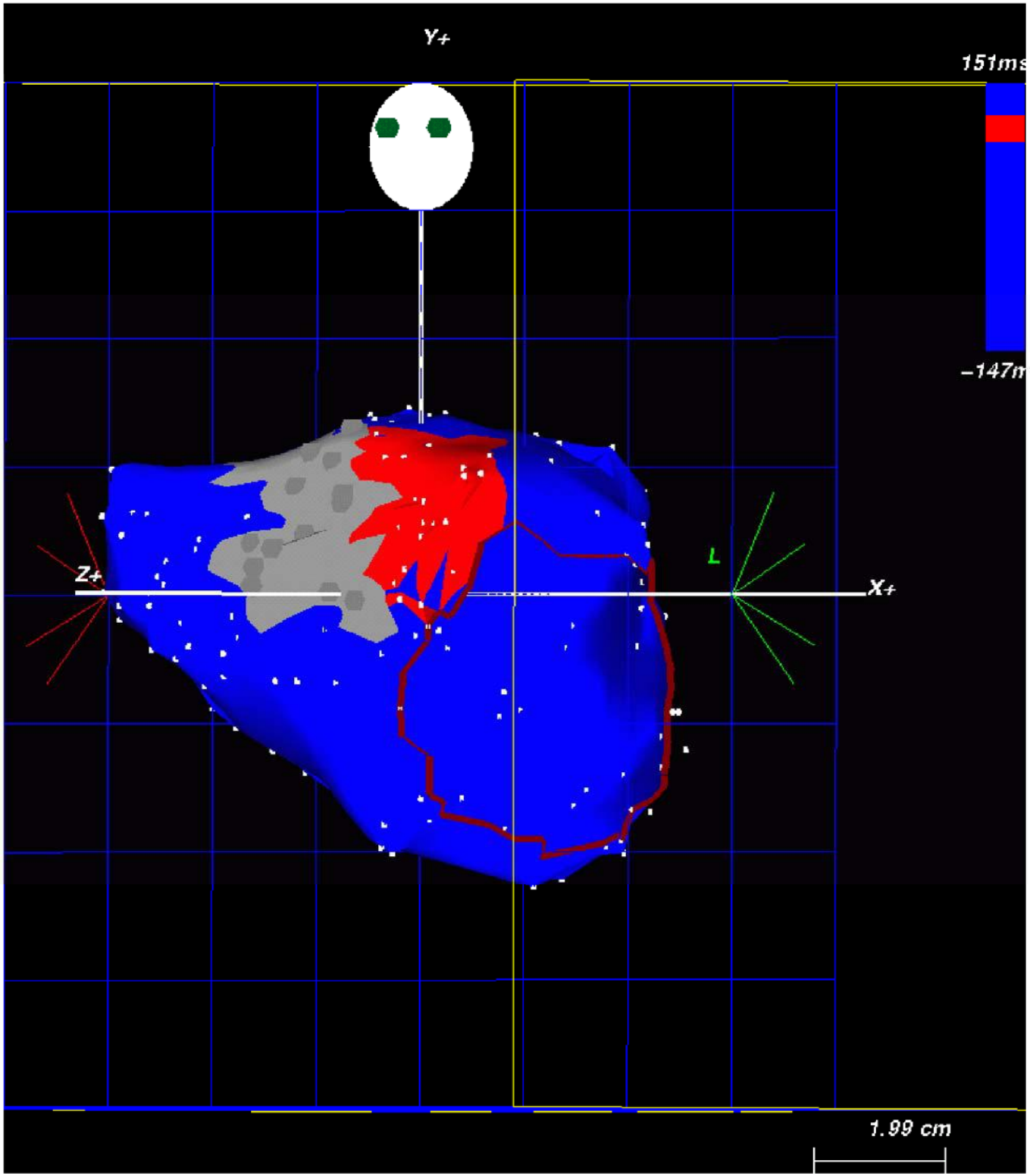


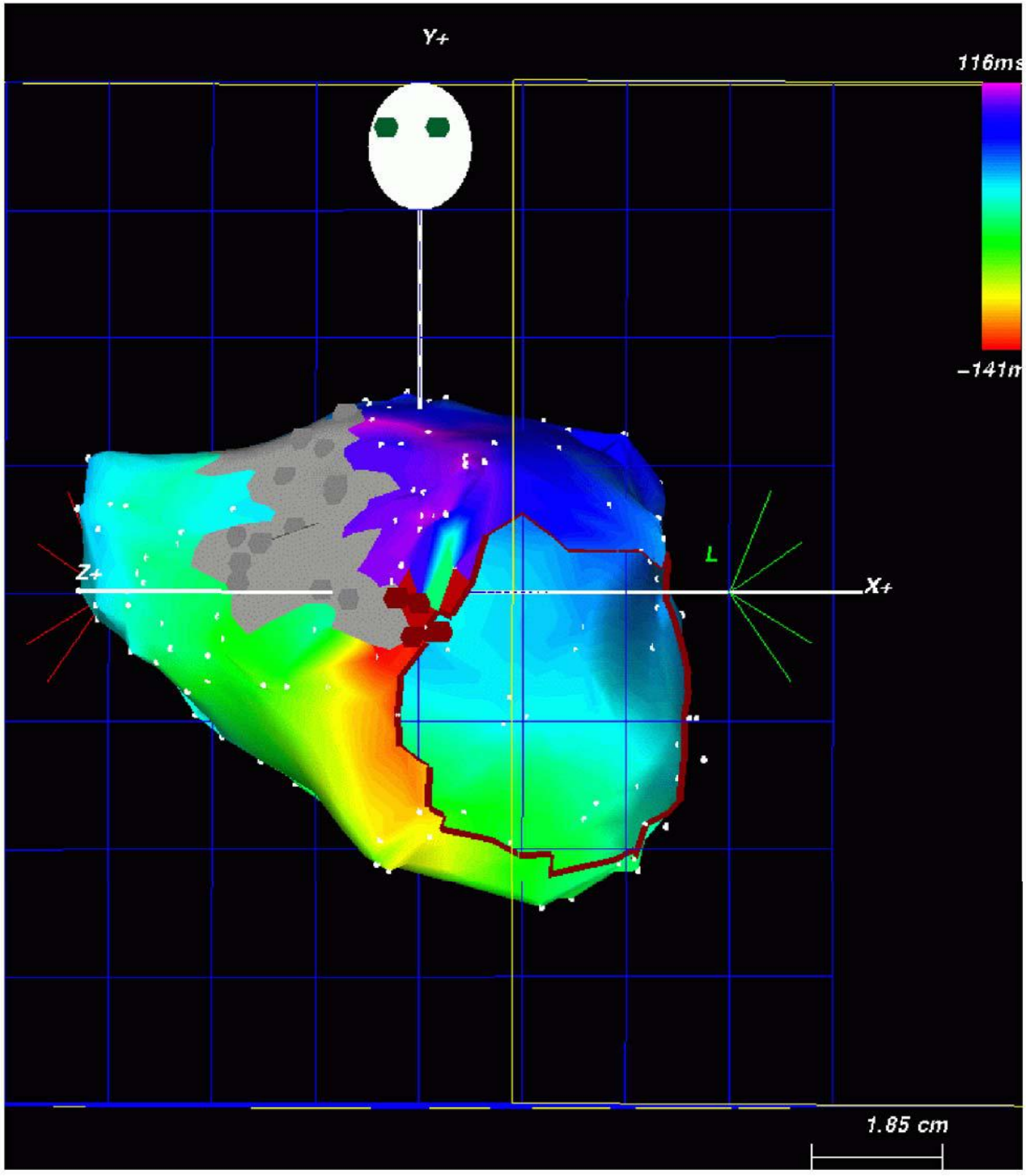

Y+
151ms
-147m
Zt
L
X+
1.99 cm


Y+
151ms
-147m
Z+
L
X+
1.99 cm

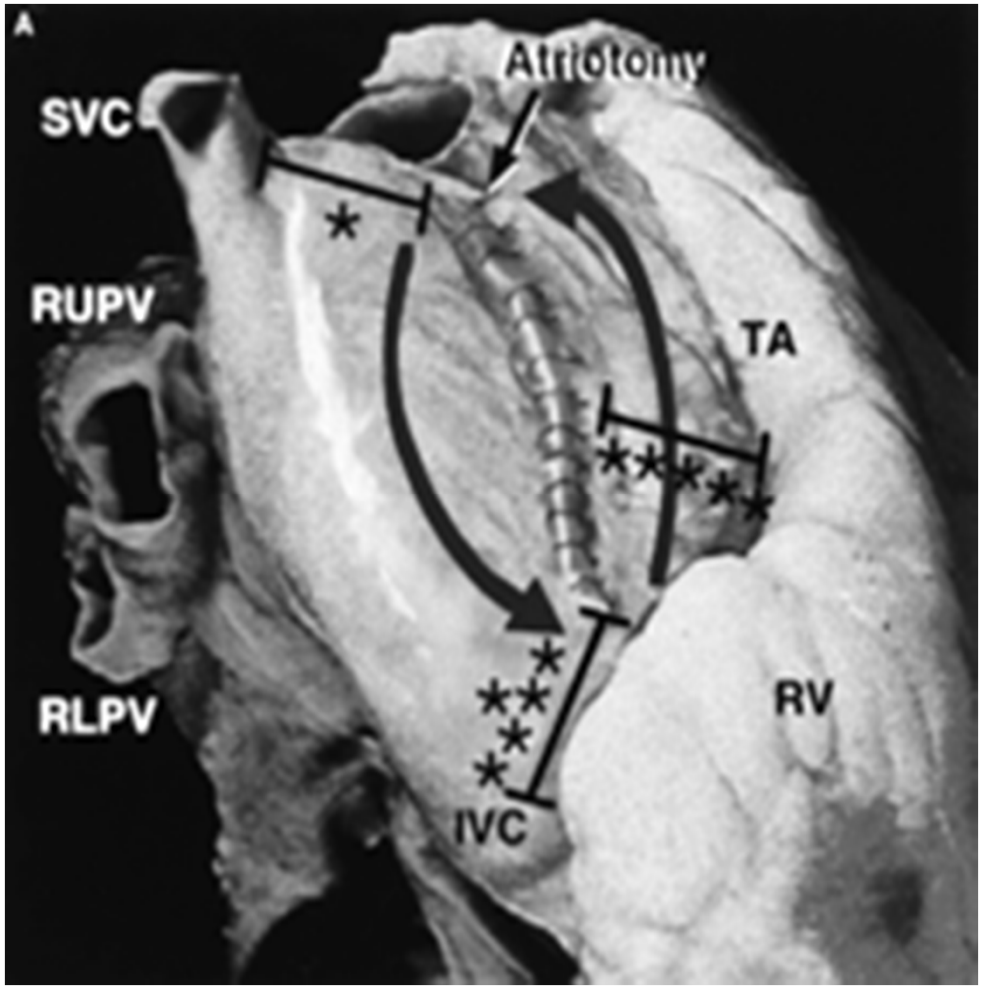

Y+
151ms
-147m
Z+
L
X+
1.99 cm

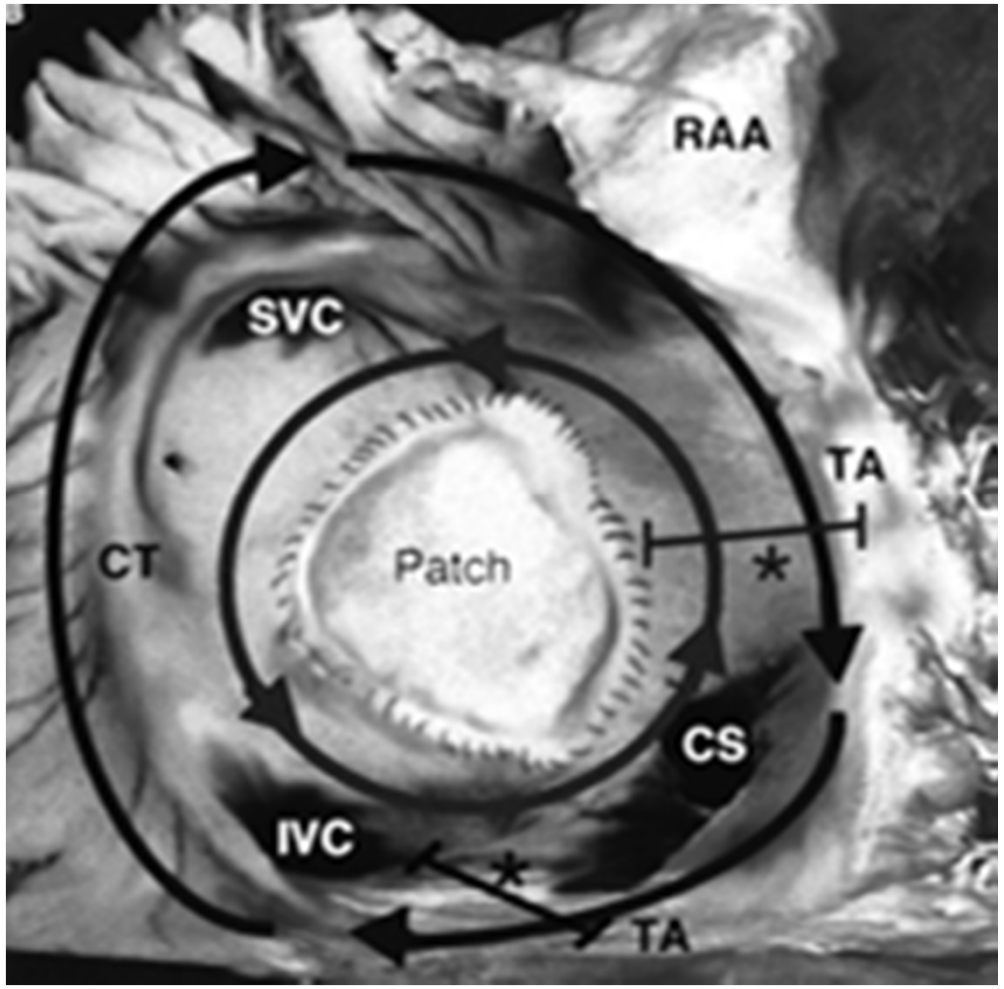

Y+
151ms
-147m
Z+
L
X+
1.99 cm


Y+
151ms
-147m
Z+
L
X+
1.99 cm


Y+
116ms
-141m
Z+
X+
L
1.85 cm

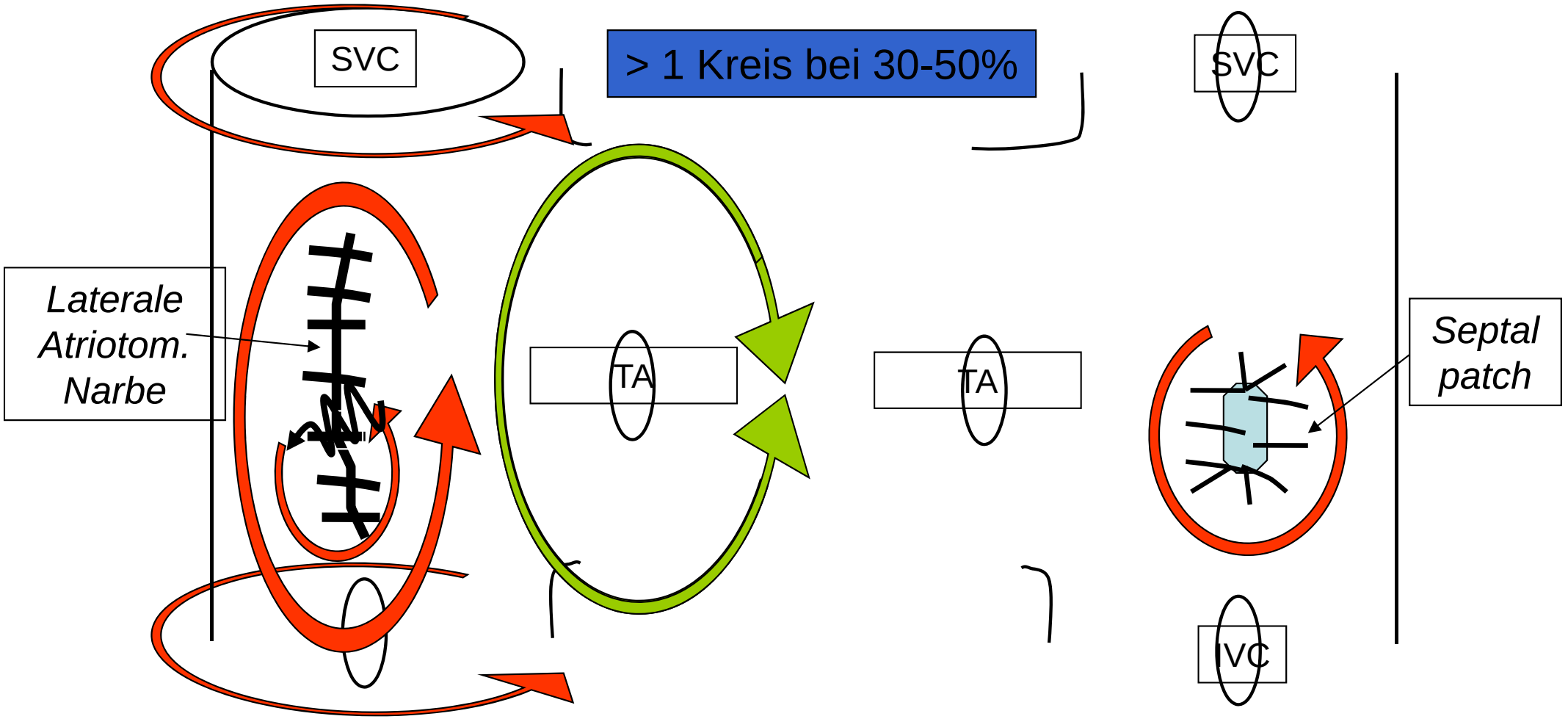
Inzisionales Vorhofflattern





Kalman et. al. *Circulation.* 1996;93:502-512

Vorhofflattern nach OP



„Ungewöhnliches“ Vorhofflattern

Prozedurvorbereitung

- **Zusätzlich zur Vorhofflatter-Prozedurvorbereitung bei Z.n. Herz-OP: OP-Bericht, da inzisionale Tachykardie möglich.**
- **Linksatriale Makro-Reentry-Tachykardie: TEE**

Paroxysmales Vorhofflimmern

Indikation

- **Symptomatik: EHRA II-IV**
- **Erstlinientherapie möglich (statt AA) bei strukturell Herzgesunden**
- **> 3 Ereignisse pro Jahr**

Perisitierendes Vorhofflimmern

Indikation

- **Strukturell herzgesund (wie paroxysmal):**
  - Wie paroxysmal
- **Strukturell herzkrank oder lang persistierendes AF (>1 Jahr)**
  - Amiodaron-Aufsättigung
  - KV
  - Dann Entscheidung zur Ablation

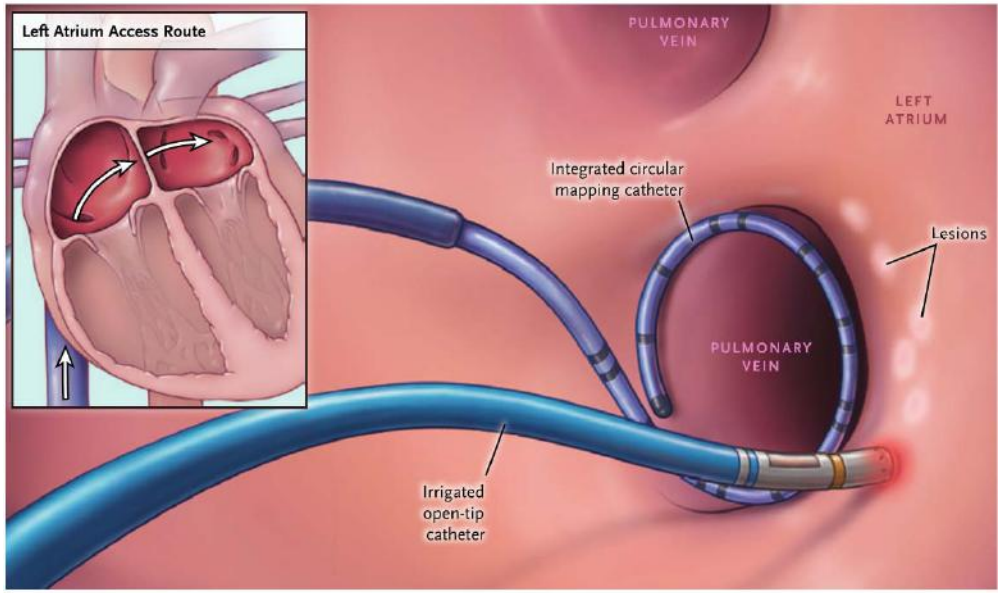
Paroxysmales Vorhofflimmern

Prozedurvorbereitung

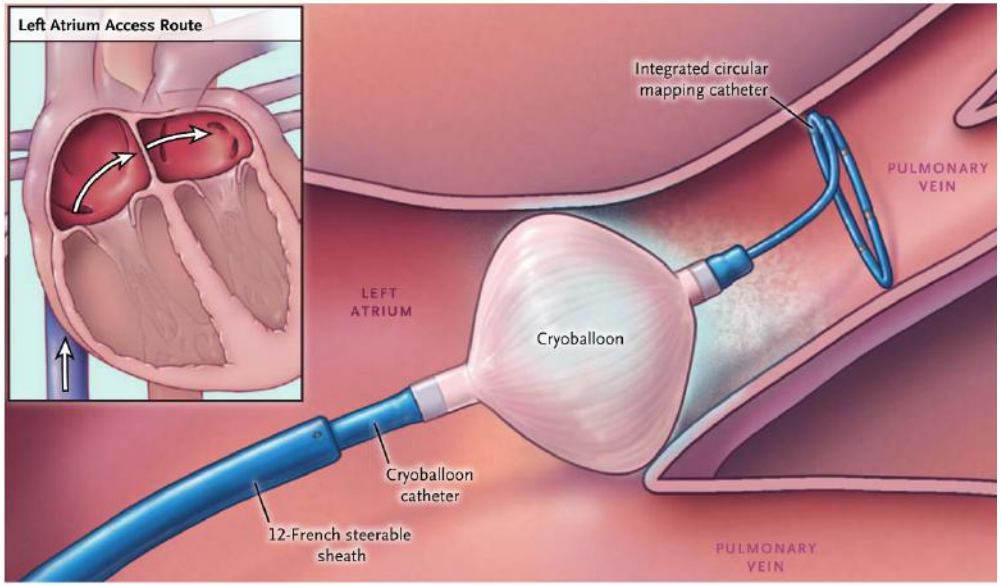
- TEE: Vitien, LA-Größe, Septum (-aneurysma)?
- Cardio-MRT: LA-Rekonstruktion, Vorhofnarbe?
- Antikoagulation mit Marcumar/ Falithrom weitergeben
- NOAK > 24h vor Prozedur je nach Nierenfunktion absetzen
- Kein Bridging!
- Am Abend nach der Prozedur halbe gewichtsadaptierte Dosis Clexane

Ablation von Vorhofflimmern

RF



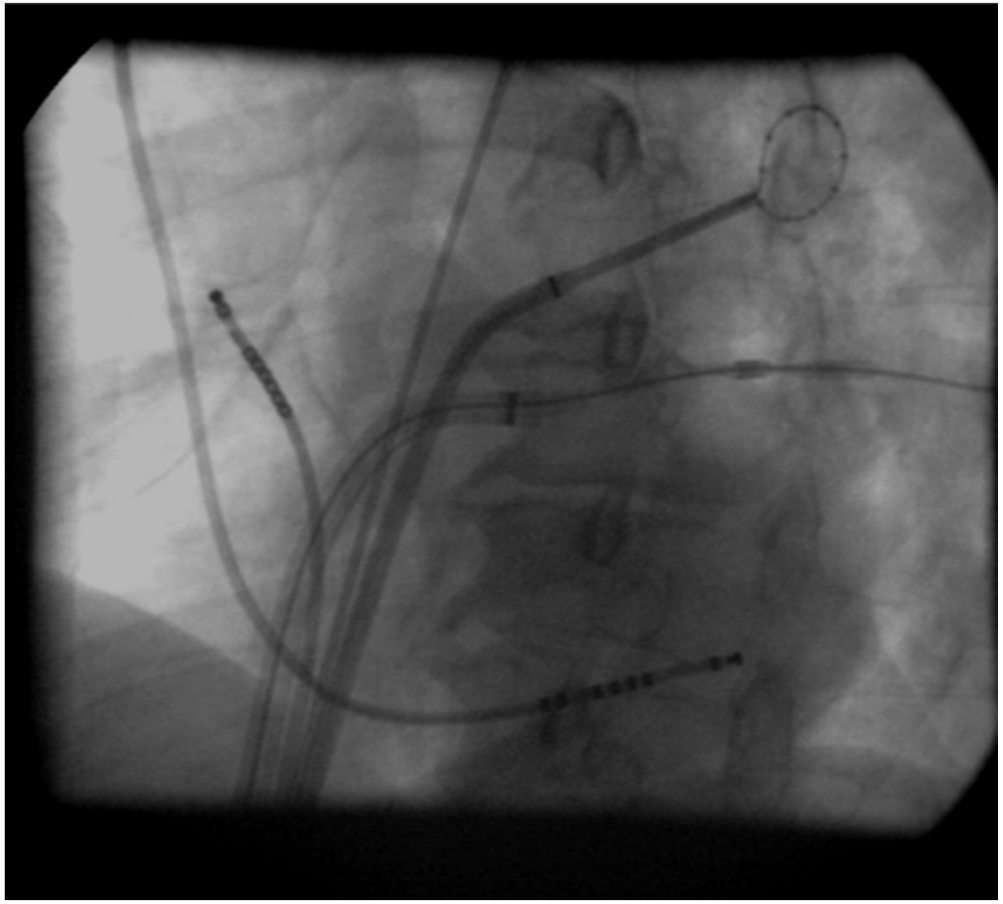
Cryo



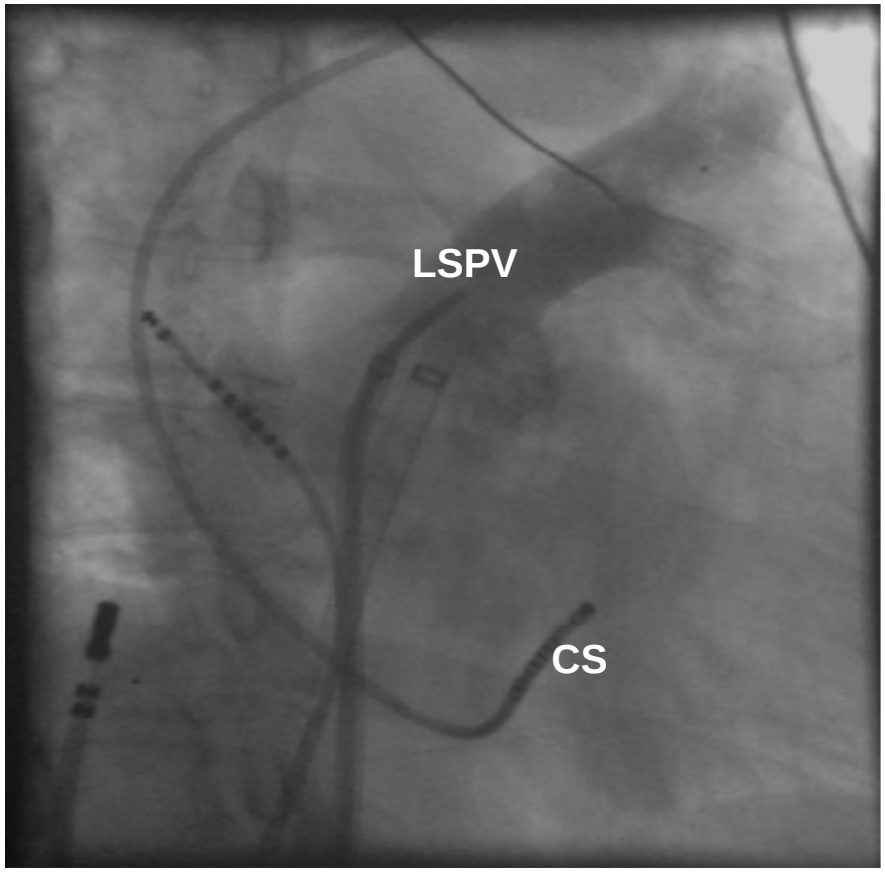
Ablation von Vorhofflimmern

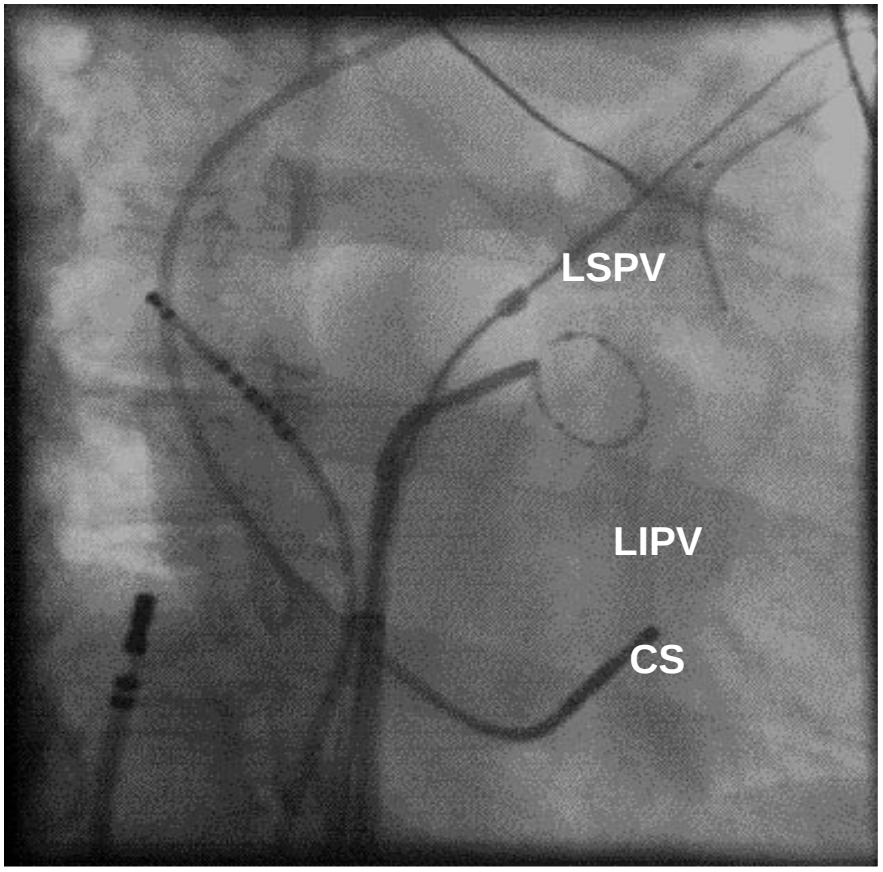
RF

Cryo

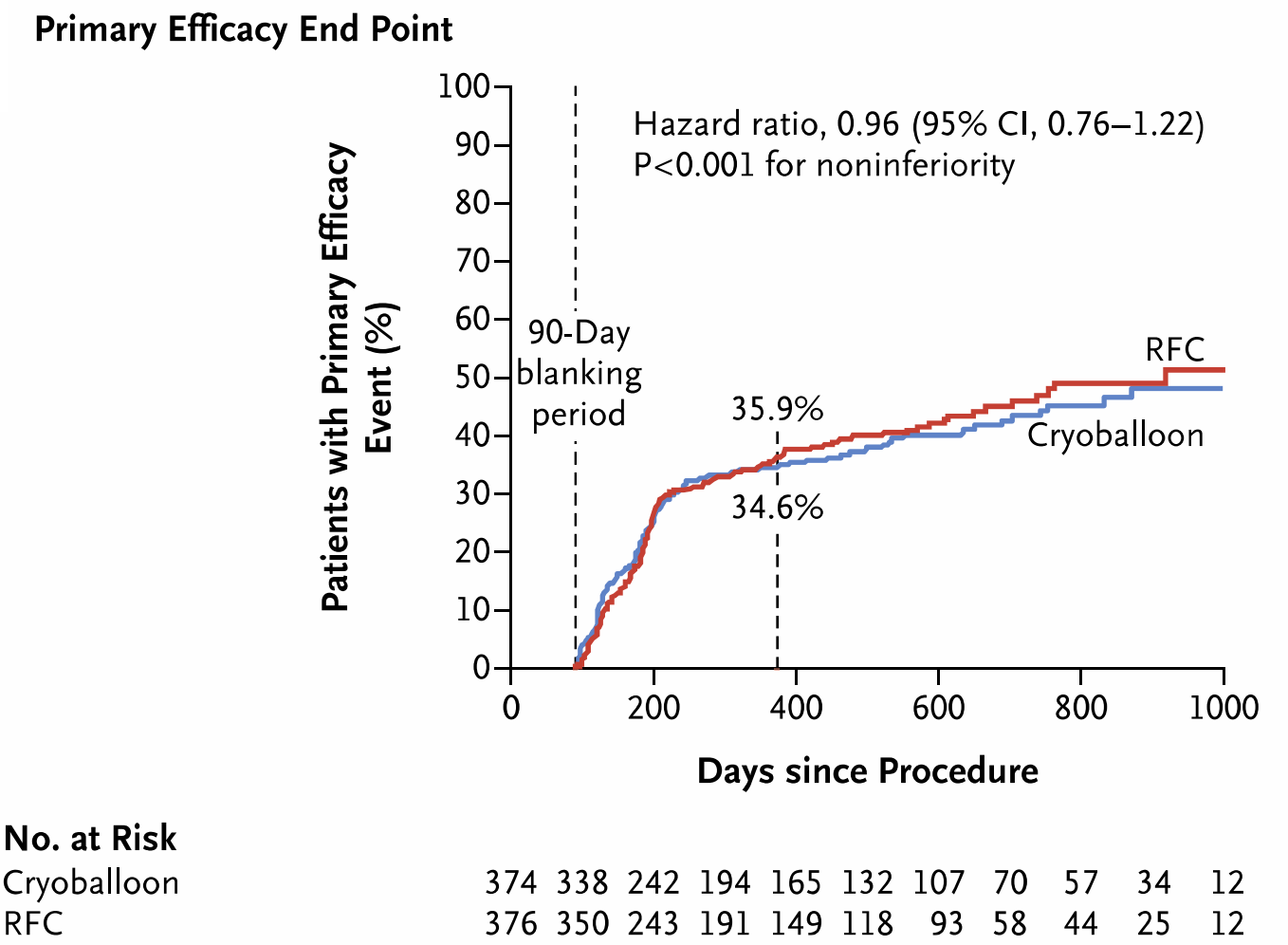


PV Isolation with a Cryo-Balloon





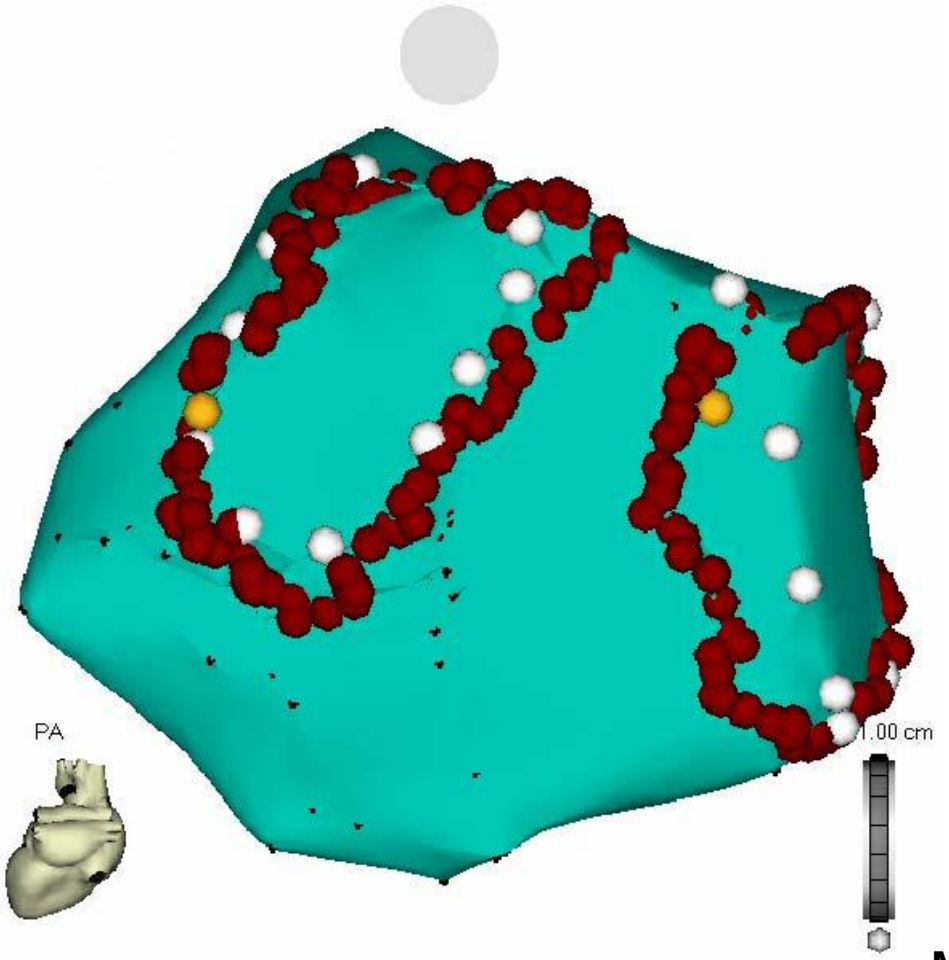
CRYO vs. RF

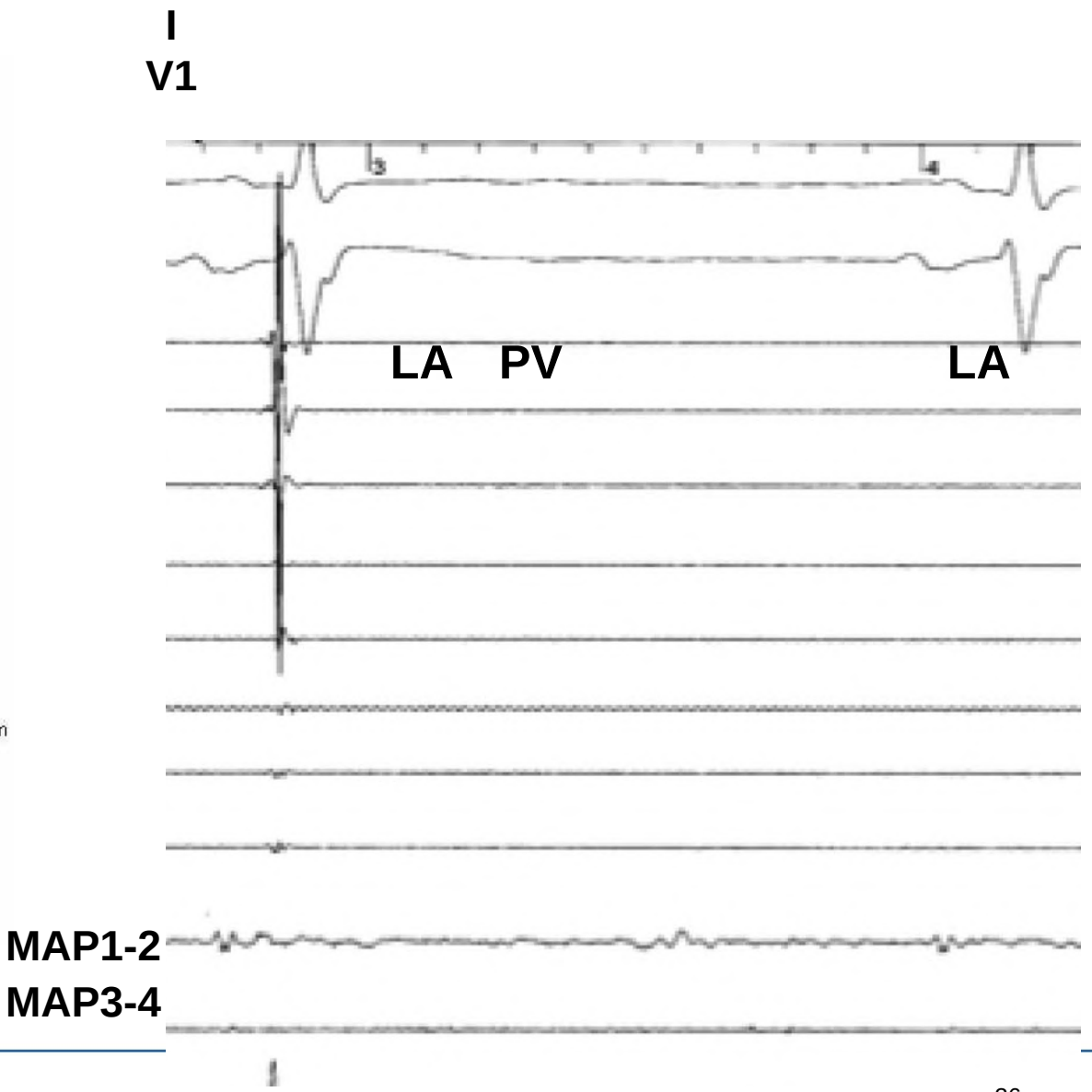

Primary Efficacy End Point
Patients with Primary Efficacy Event (%)
100
90
80
70
60
50
40
30
20
10
0
Hazard ratio, 0.96 (95% CI, 0.76–1.22)
P<0.001 for noninferiority
90-Day blanking period
35.9%
34.6%
RFC
Cryoballoon
0
200
400
600
800
1000
Days since Procedure
No. at Risk
Cryoballoon 374 338 242 194 165 132 107 70 57 34 12
RFC 376 350 243 191 149 118 93 58 44 25 12

Komplikationen

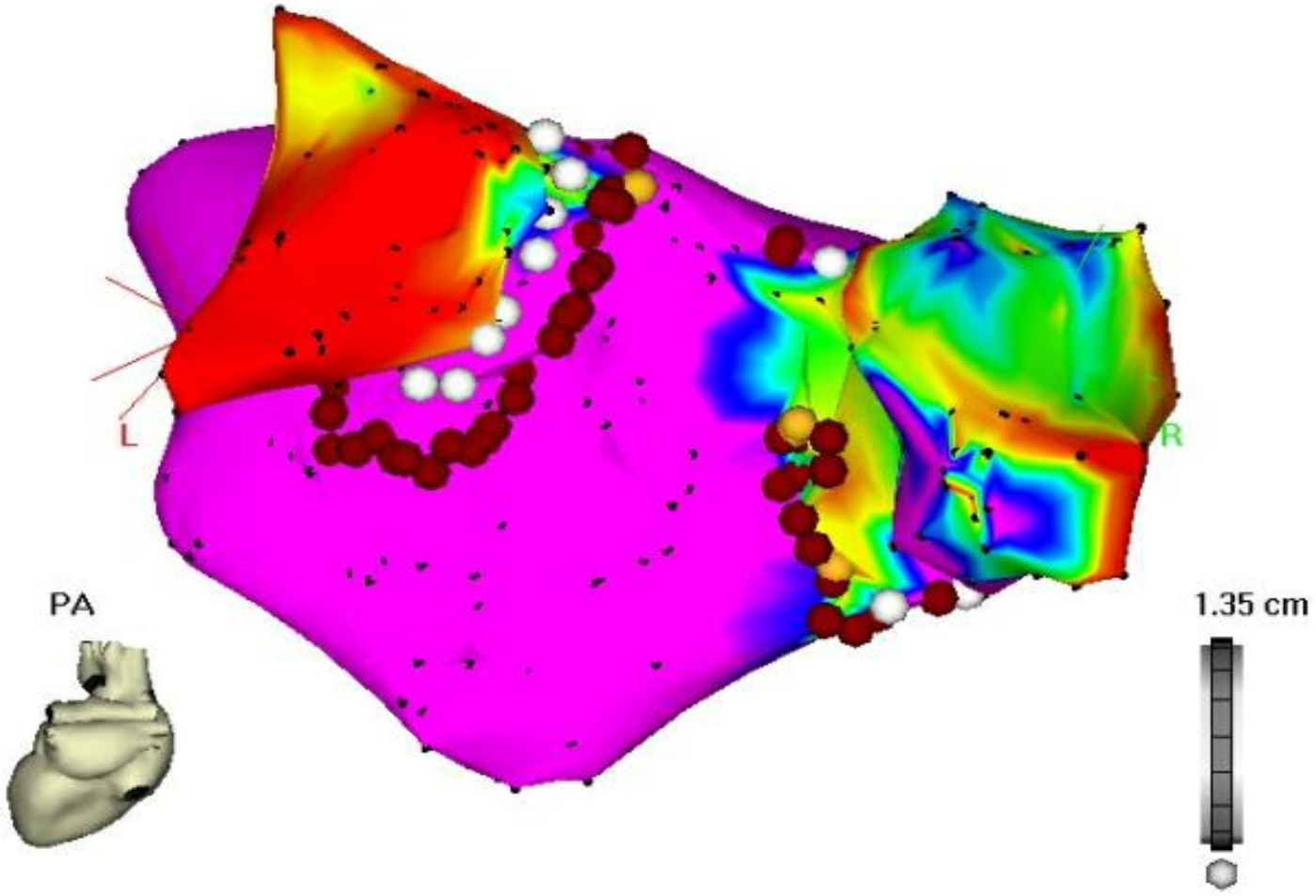
End Point	Radiofrequency Group (N = 376)	Cryoballoon Group (N = 374)	P Value*
	no. of patients (%)		
Primary safety end point†	51 (12.8)‡	40 (10.2)‡	
Death from any cause§	0	2 (0.5)¶	0.50
Stroke or TIA from any cause§	2 (0.5)	2 (0.5)	1.00
Atrial arrhythmia§‖	13 (3.5)	8 (2.1)	0.38
Atrial flutter or atrial tachycardia	10 (2.7)	3 (0.8)	0.09
Non–arrhythmia-related serious adverse events§	36 (9.6)	28 (7.5)	0.36
Groin-site complication**	16 (4.3)	7 (1.9)	0.09
Unresolved phrenic nerve injury††			
At discharge	0	10 (2.7)	0.001
At 3 months	0	2 (0.5)	0.25
At >12 months	0	1 (0.3)	0.50
Cardiac tamponade or pericardial effusion	5 (1.3)	1 (0.3)	0.22

Re-Ablation RF



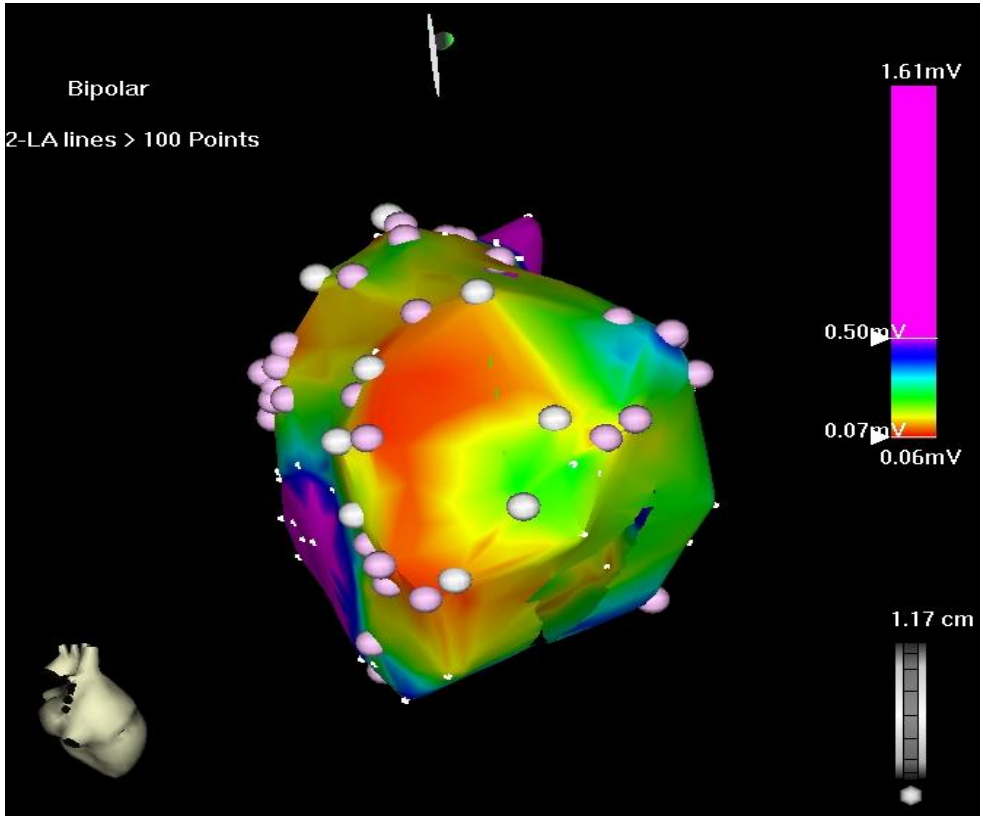


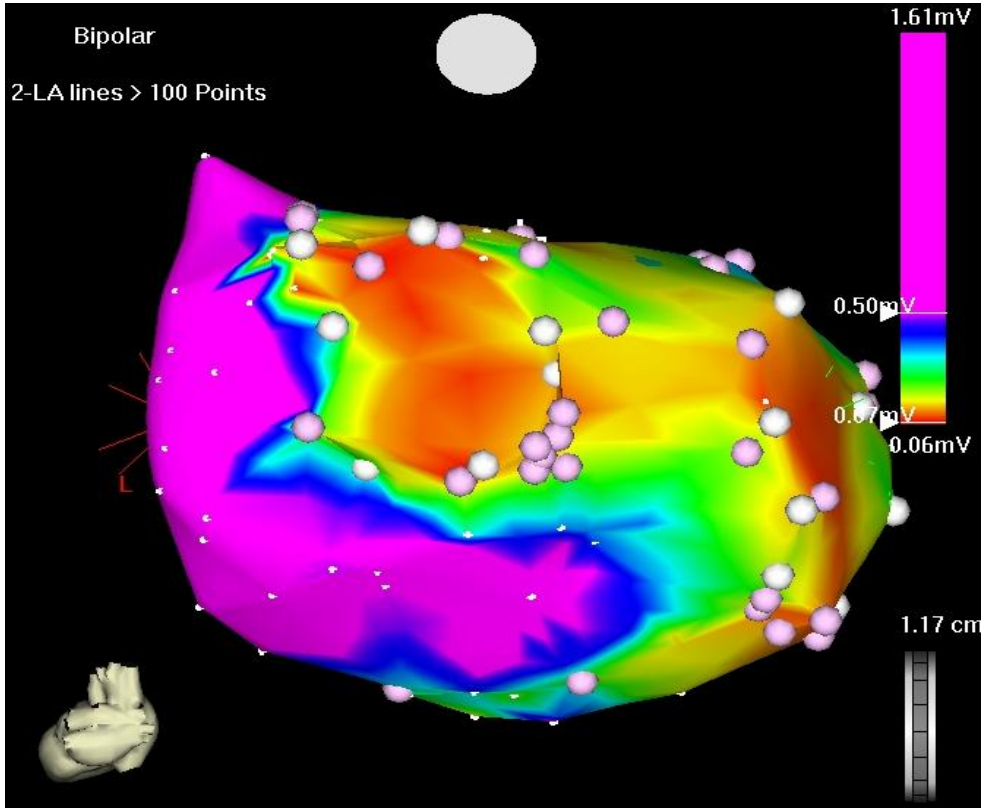
Re-Ablation Cryo



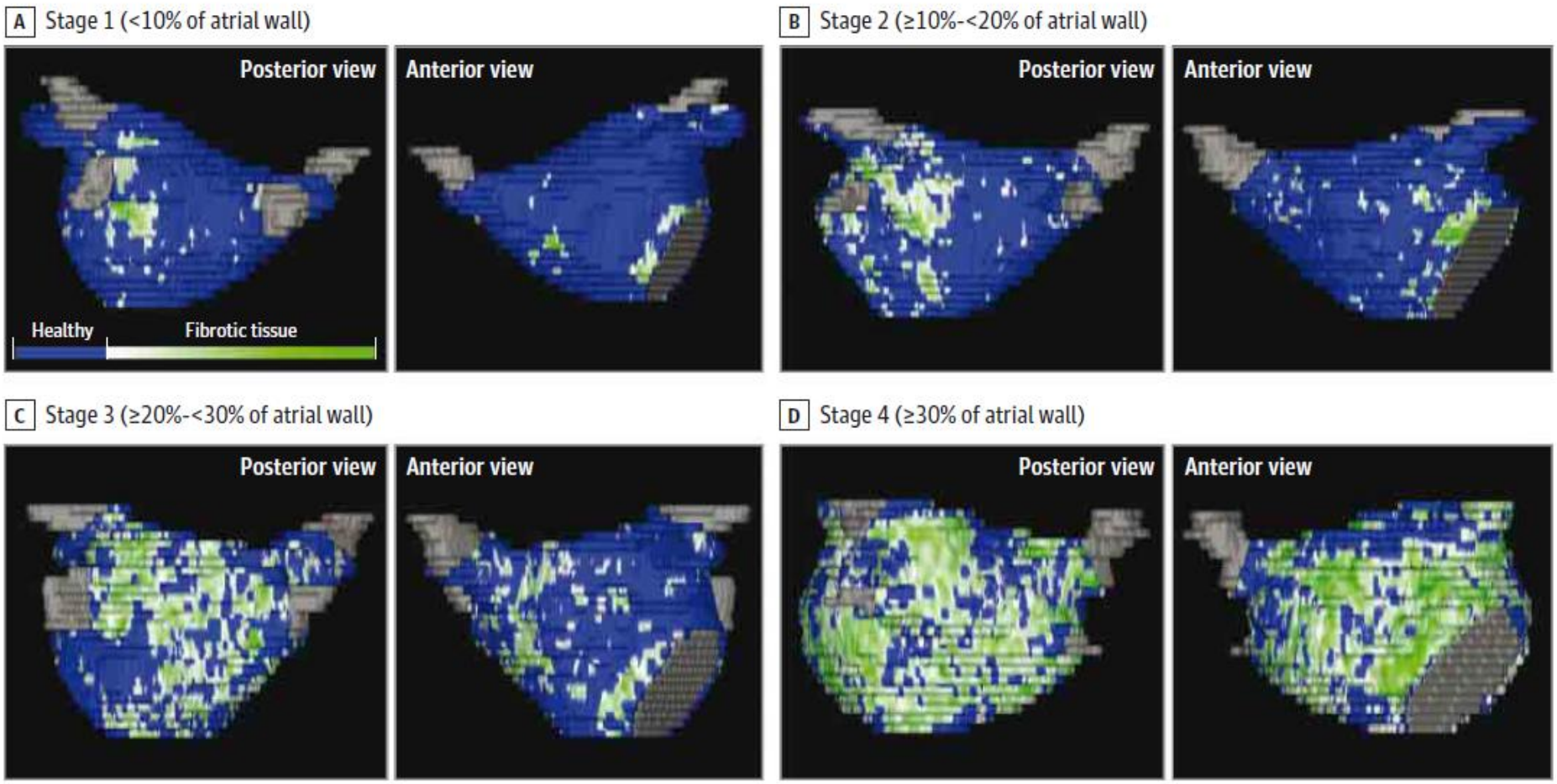
PA

Electroanatomical Map and Scar



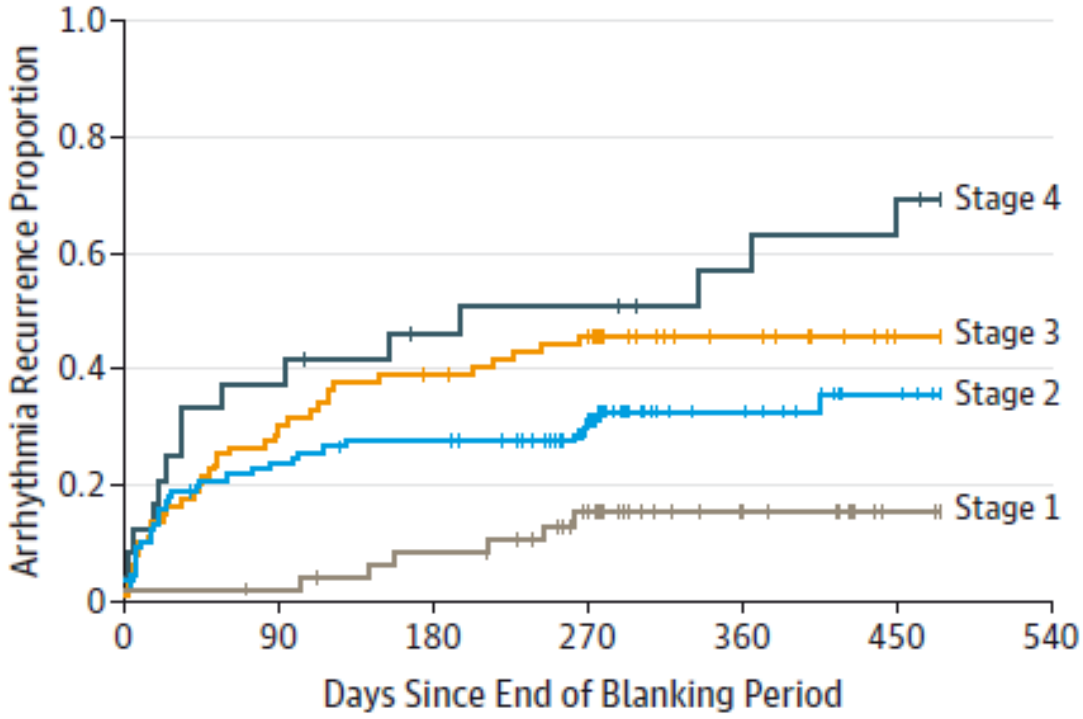


Scar and Success of AF Ablation



Marrouche et al.; JAMA 2014

Scar and Success of AF Ablation



No. at risk						
Stage 4	24	15	11	10	7	6
Stage 3	80	56	47	41	19	12
Stage 2	107	79	74	58	26	15
Stage 1	49	47	43	33	13	4

Marrouche et al.; JAMA 2014

Perisitierendes Vorhofflimmern

Prozedurvorbereitung

- **Strukturell herzgesund (wie paroxysmal):**
  - TEE: Vitien, LA-Größe, Septum (-aneurysma)?
  - Cardio-MRT: LA-Rekonstruktion, Vorhofnarbe?
  - Antikoagulation mit Marcumar/ Falitrom weitergeben
  - NOAK mindestens 24h vor Prozedur je nach Nierenfunktion absetzen
  - Kein Bridging
  - Am Abend der Prozedur halbe gewichtsadaptierte Dosis Clexane
- **Strukturell herzkrank**
  - Amiodaron-Aufsättigung
  - KV
  - Dann Entscheidung zur Ablation

VES/Ventrikuläre Tachykardie ohne strukturelle Herzerkrankung

Indikation

- **Symptomatisch (EHRA II-IV)**
- **Herzinsuffizenz (Tachymyopathie): >10 000/24h**

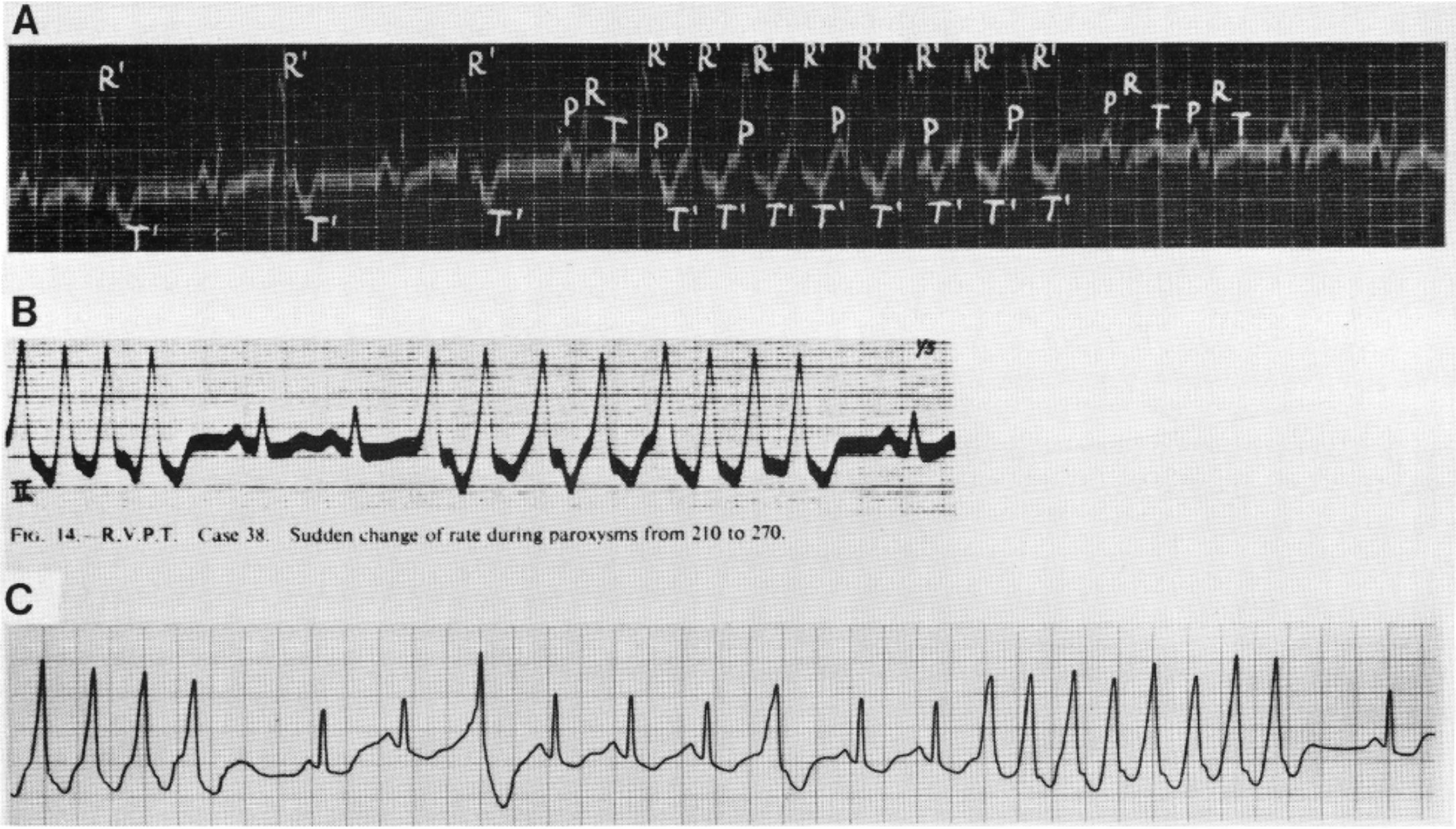
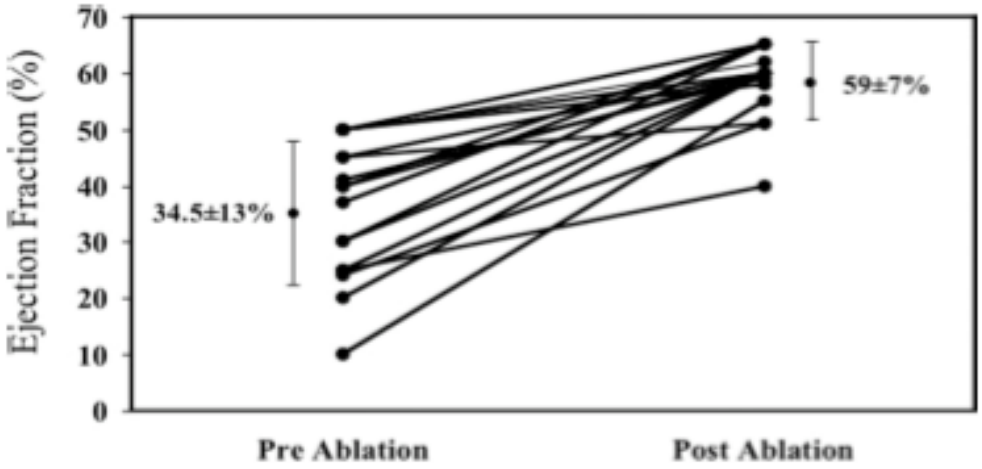


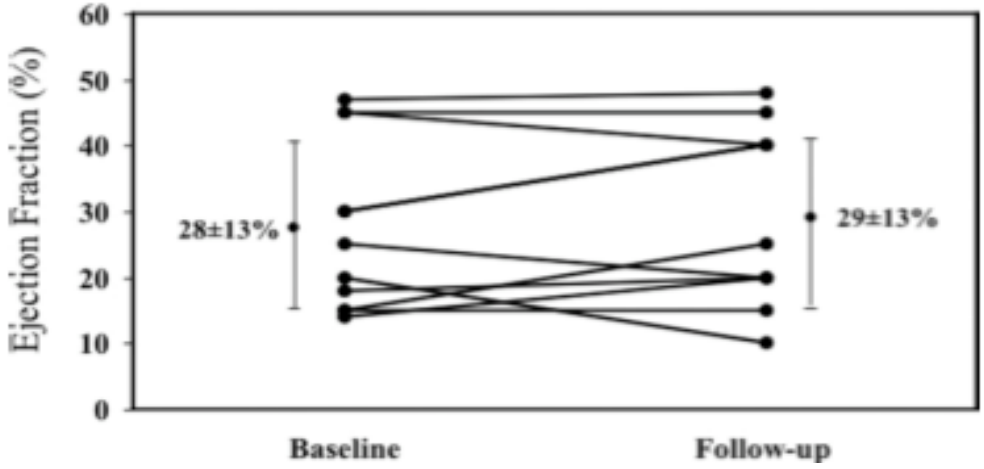
FIG. 14.—R.V.P.T. Case 38. Sudden change of rate during paroxysms from 210 to 270.

FIGURE 1. *Lead II electrocardiogram tracings of paroxysmal (repetitive) ventricular tachycardia.* Tracing A: *From Gallavardin, original publication in 1922.*[2] *(Reproduced with permission from* Archives des Maladies du Coeur.*)* Tracing B: *From Parkinson and Papp's original publication in 1947.*[3] *(Reproduced with permission from the* British Heart Journal.*)* Tracing C: *From one of our patients with episodes of nonsustained and sustained monomorphic ventricular tachycardia. All three tracings are strikingly similar. Tracings show sinus rhythm (sinus tachycardia in tracings B and C), with ventricular extrasystoles. All three tracings show a burst of ventricular tachycardia of eight beats and atrioventricular dissociation.*

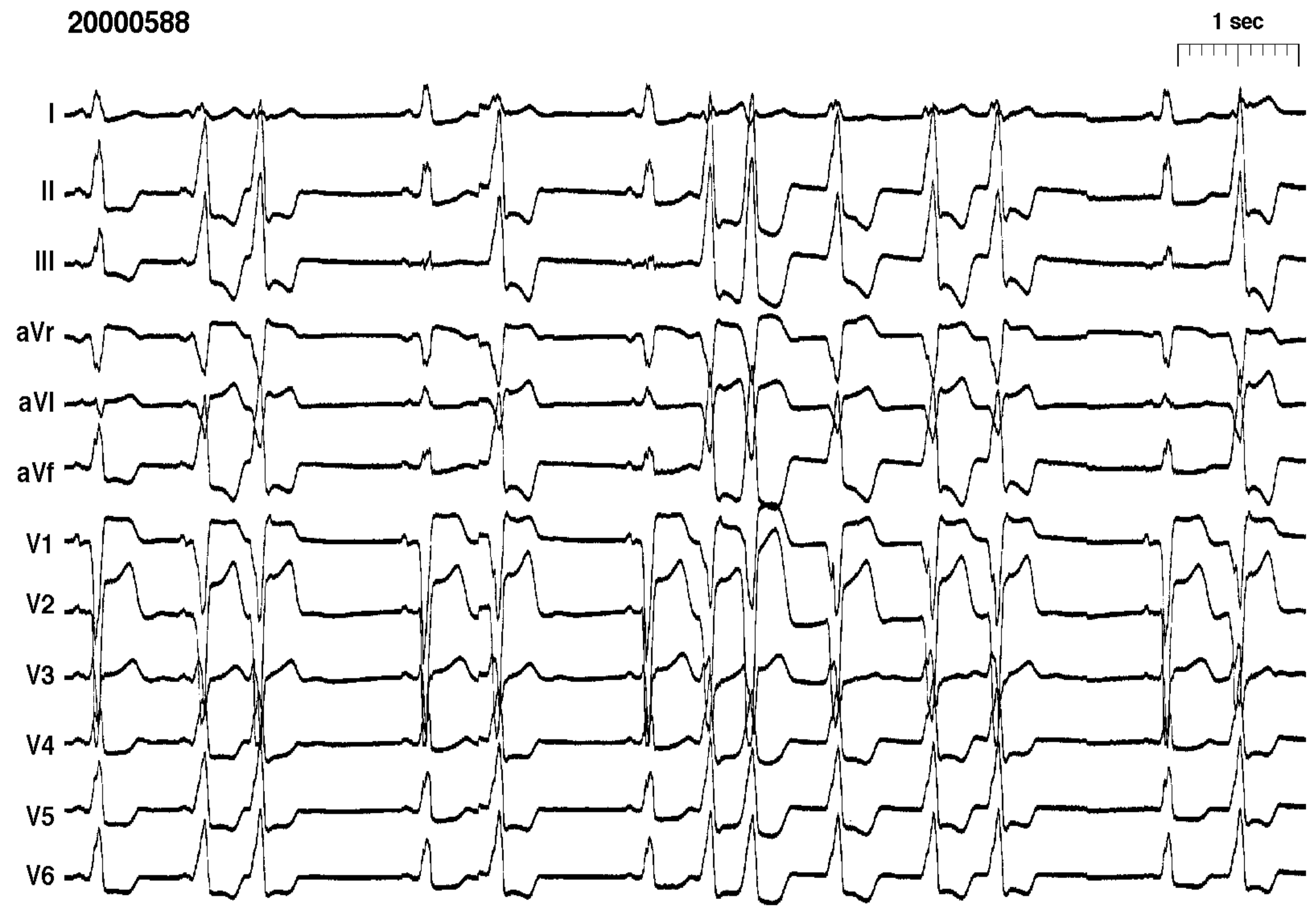
Myopathy und Ablation

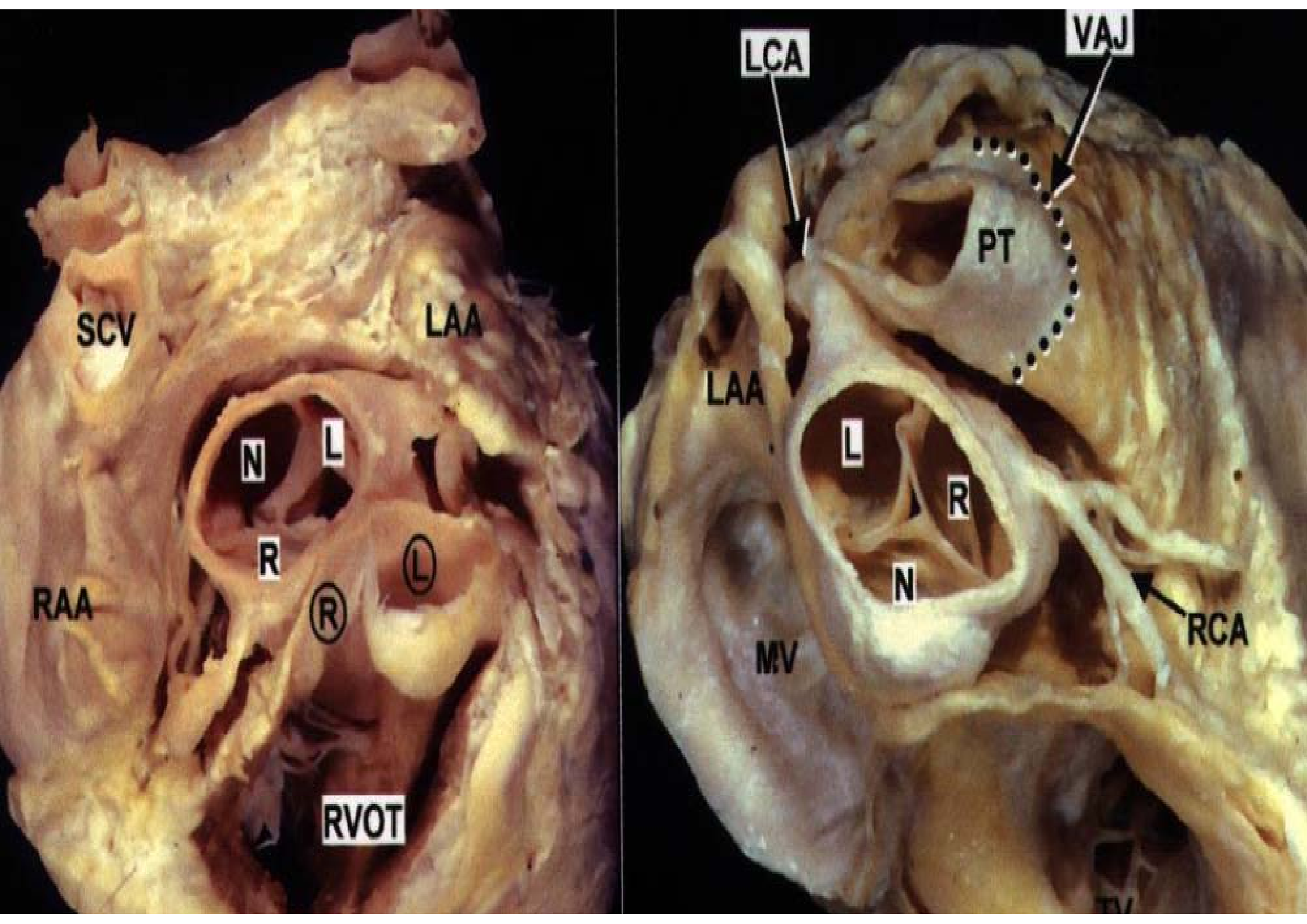
6 Monate





Bogun F, et al. Heart Rhythm 2007;4:863-7


20000588
1 sec
I
II
III
aVr
aVl
aVf
V1
V2
V3
V4
V5
V6


SCV
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R
RAA
RVOT
LCA
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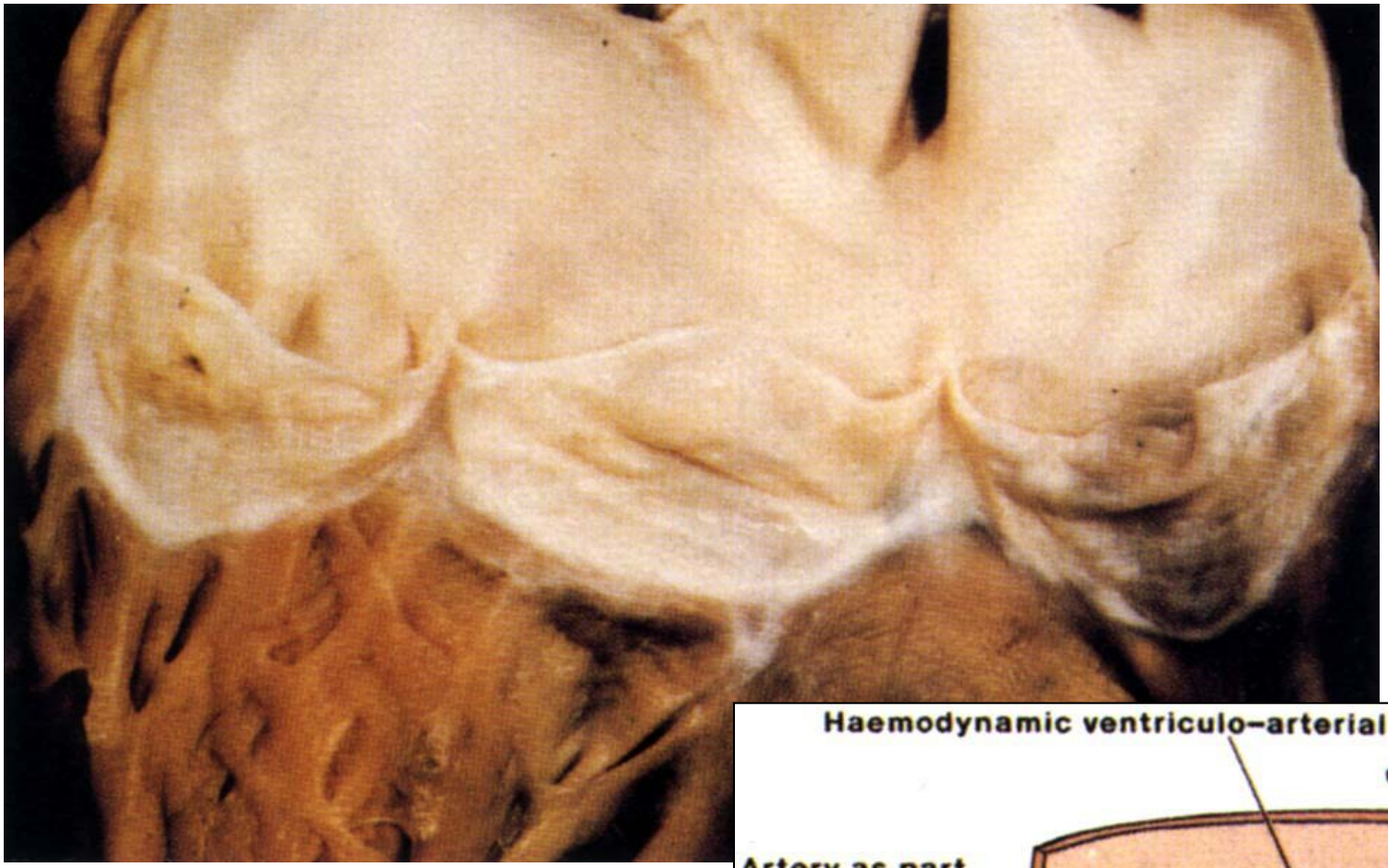
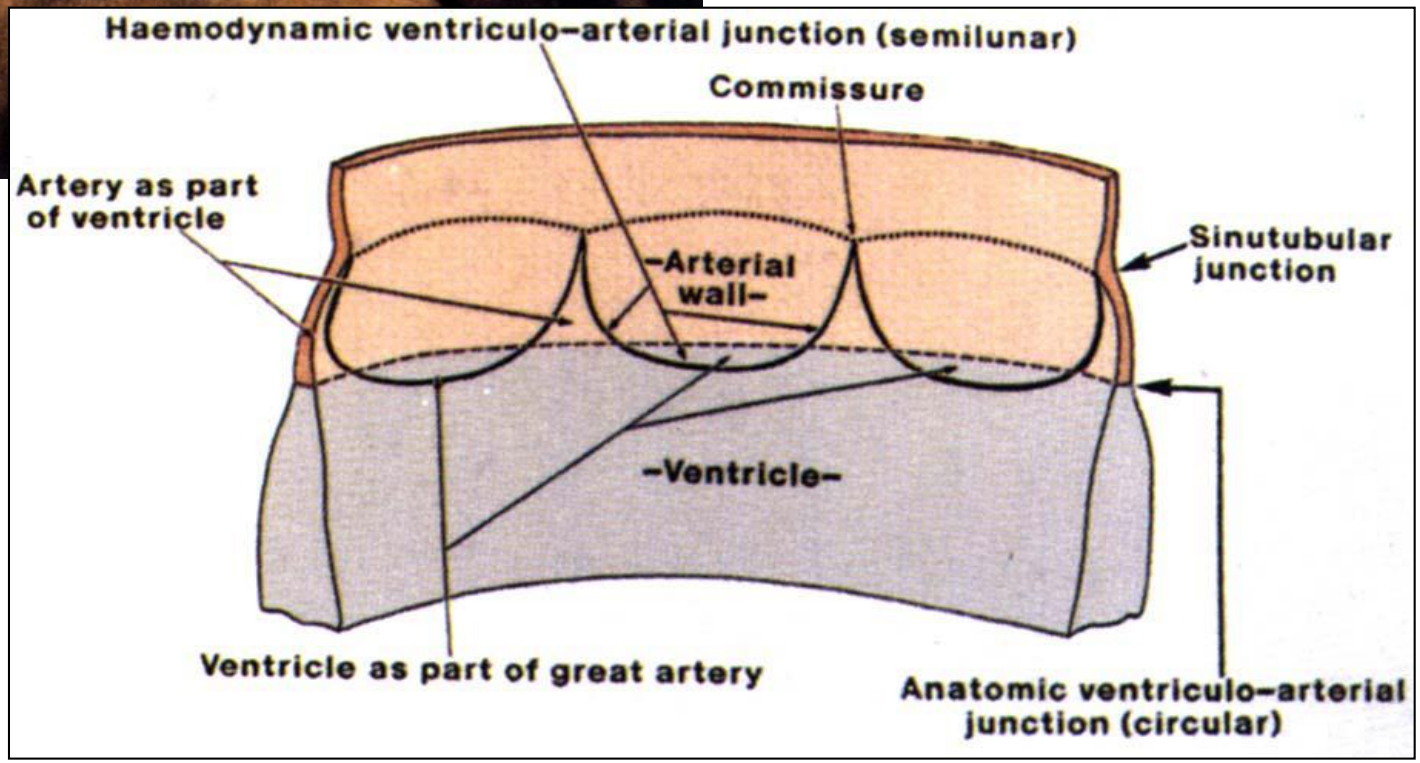
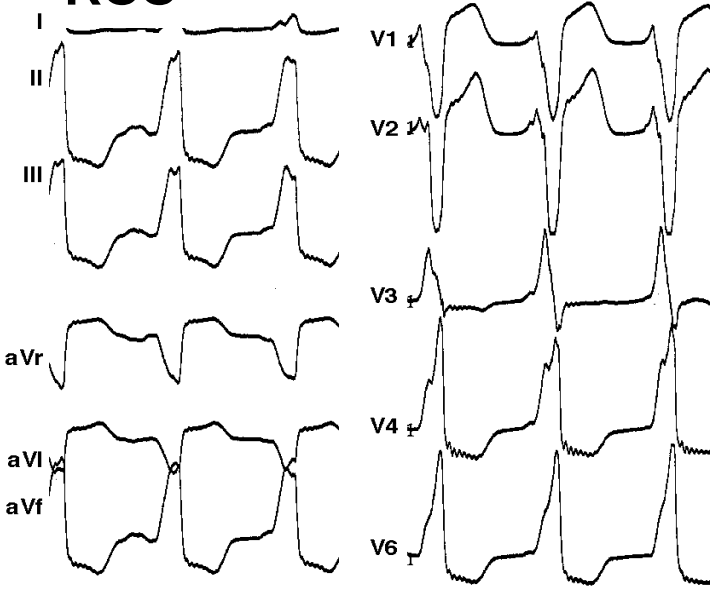
MV
RCA

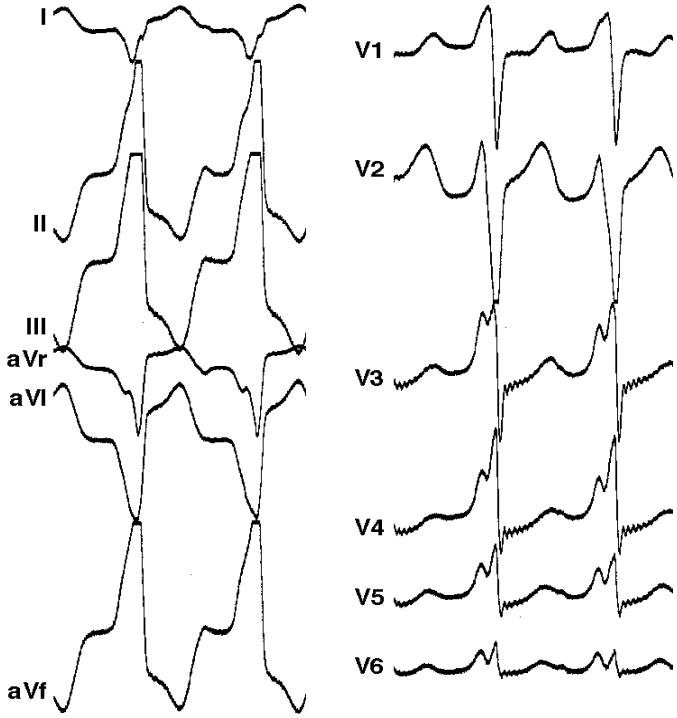


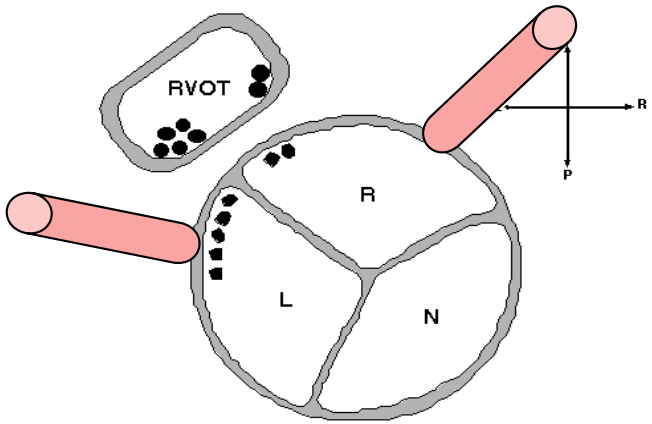

Haemodynamic ventriculo–arterial junction (semilunar)
Commissure
Artery as part of ventricle
Sinutubular junction
–Arterial wall–
–Ventricle–
Ventricle as part of great artery
Anatomic ventriculo–arterial junction (circular)

RCC

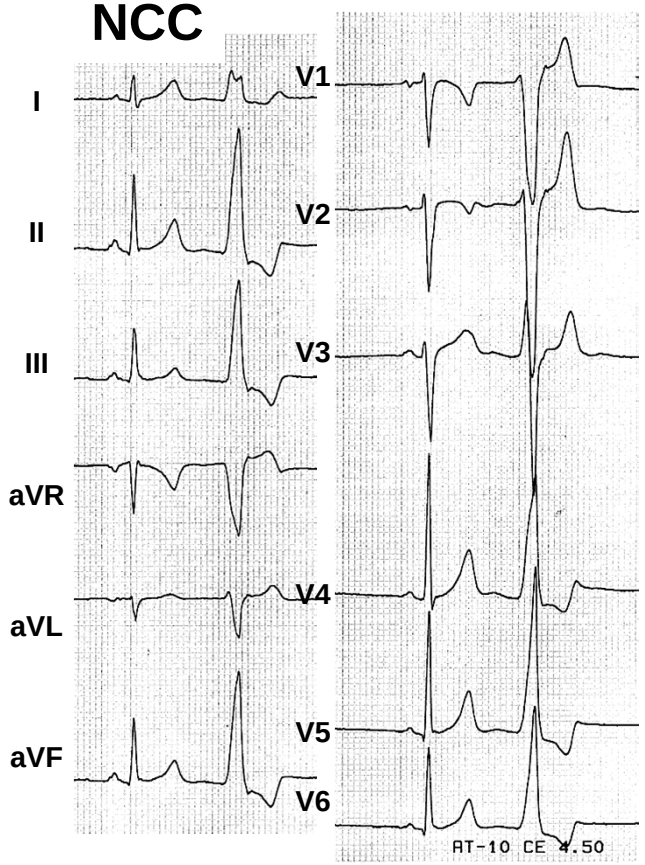

I
II
III
aVr
aVl
aVf
V1
V2
V3
V4
V6

LCC


I
II
III
aVr
aVl
aVf
V1
V2
V3
V4
V5
V6


RVOT
R
L
N
R
P

NCC


I
II
III
aVR
aVL
aVF
V1
V2
V3
V4
V5
V6
AT-10 CE 4.50

VES/Ventrikuläre Tachykardie ohne strukturelle Herzerkrankung

Prozedurvorbereitung

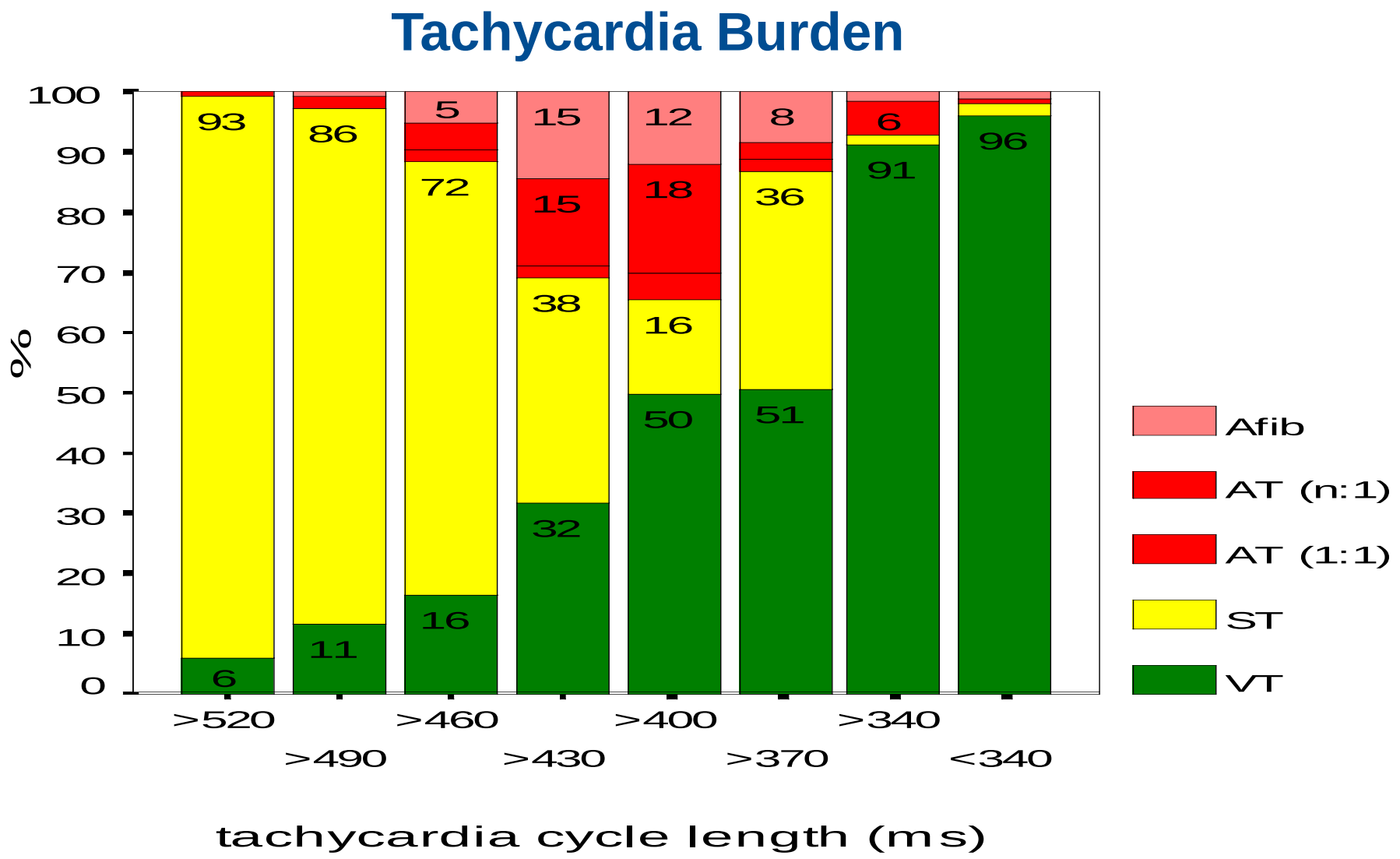
- 12-Kanal-Dokumentation der VES (Ruhe-EKG oder Ergo)
- VES mit LSB-Morphologie und nicht inferiorer Achse → Cardio-MRT oder Rechtsangio (ARVC?)
- VES mit inferiorer Achse → RVOT/LVOT
- Transthorakales Echo
- AA und Betablocker 4 HWZ vor Prozedur absetzen
- Bei seltenen VES 12-Kanal-EKG mit EP-Elektroden

VES/Ventrikuläre Tachykardie mit struktureller Herzerkrankung

Indikation

- Incessante VT (> 50% der Zeit vorhanden)
- VT –Cluster (> 2 VT/ 24h)
- > 1-2 Shocks
- Häufige nicht-anhaltende VT
- Nach erster anhaltender VT?
- Langsame VT

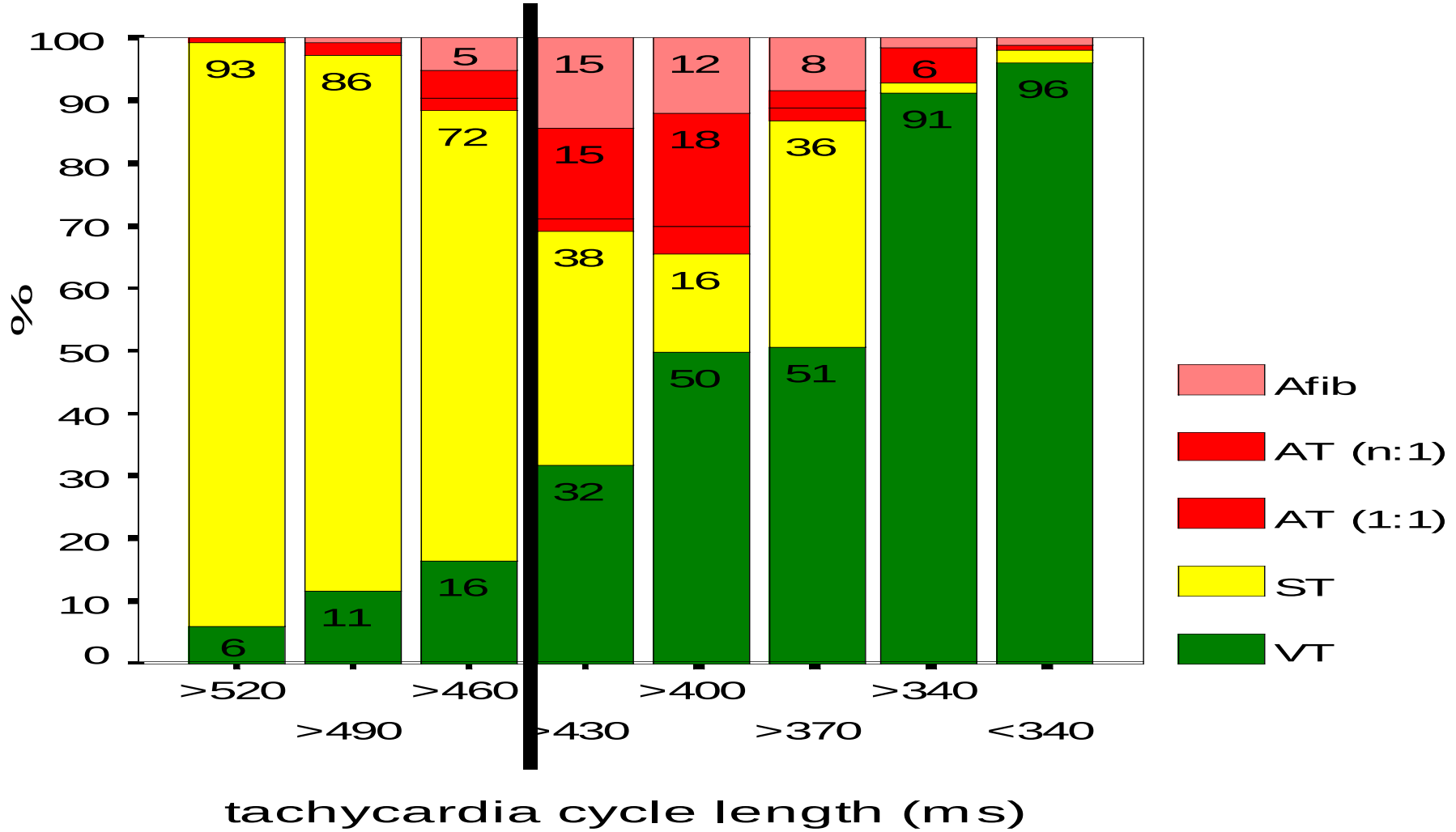
Tachycardia Detection



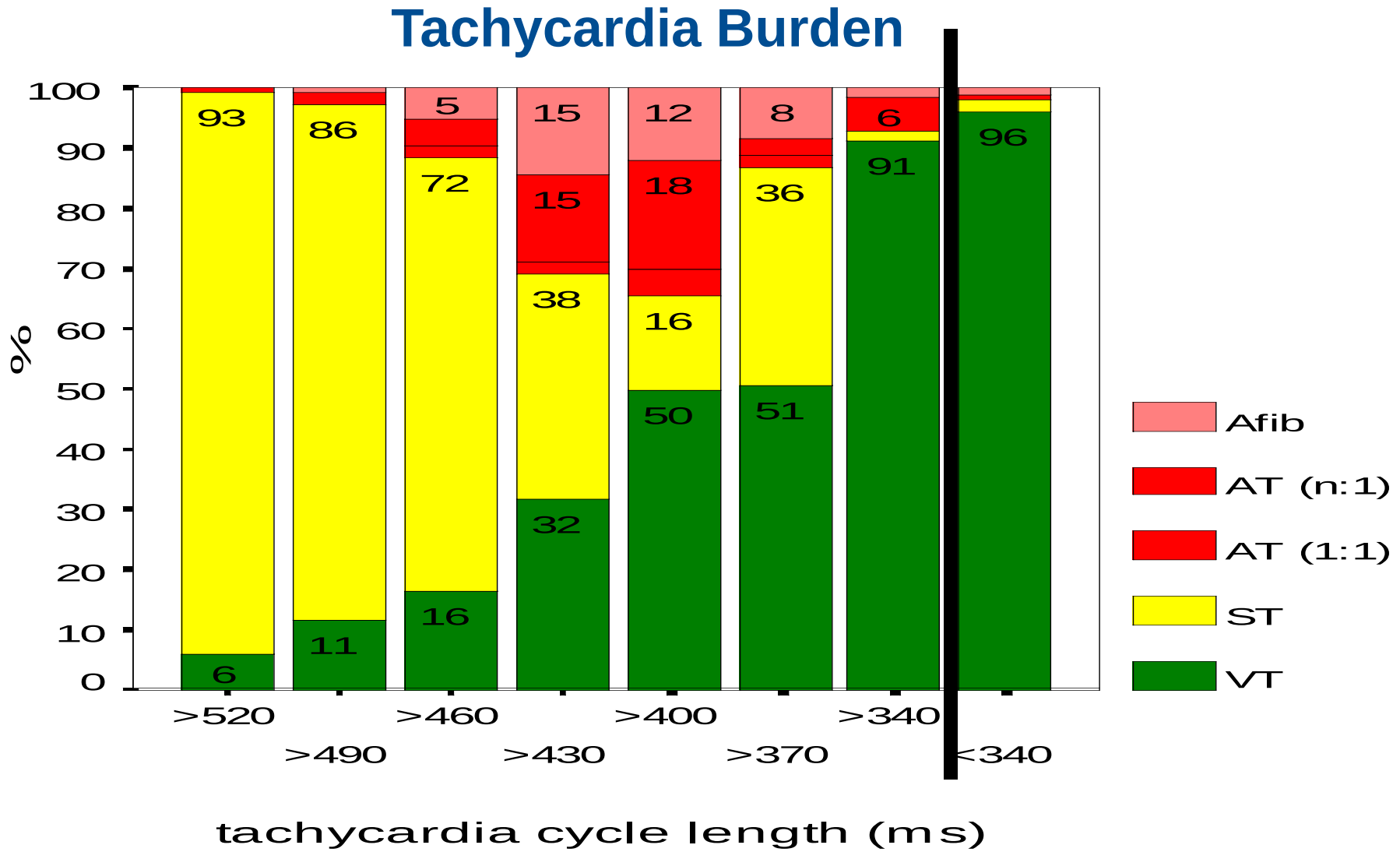
Bänsch D et al. Circulation. 2004 Aug 31;110(9):1022-9.

Tachycardia Detection

Tachycardia Burden

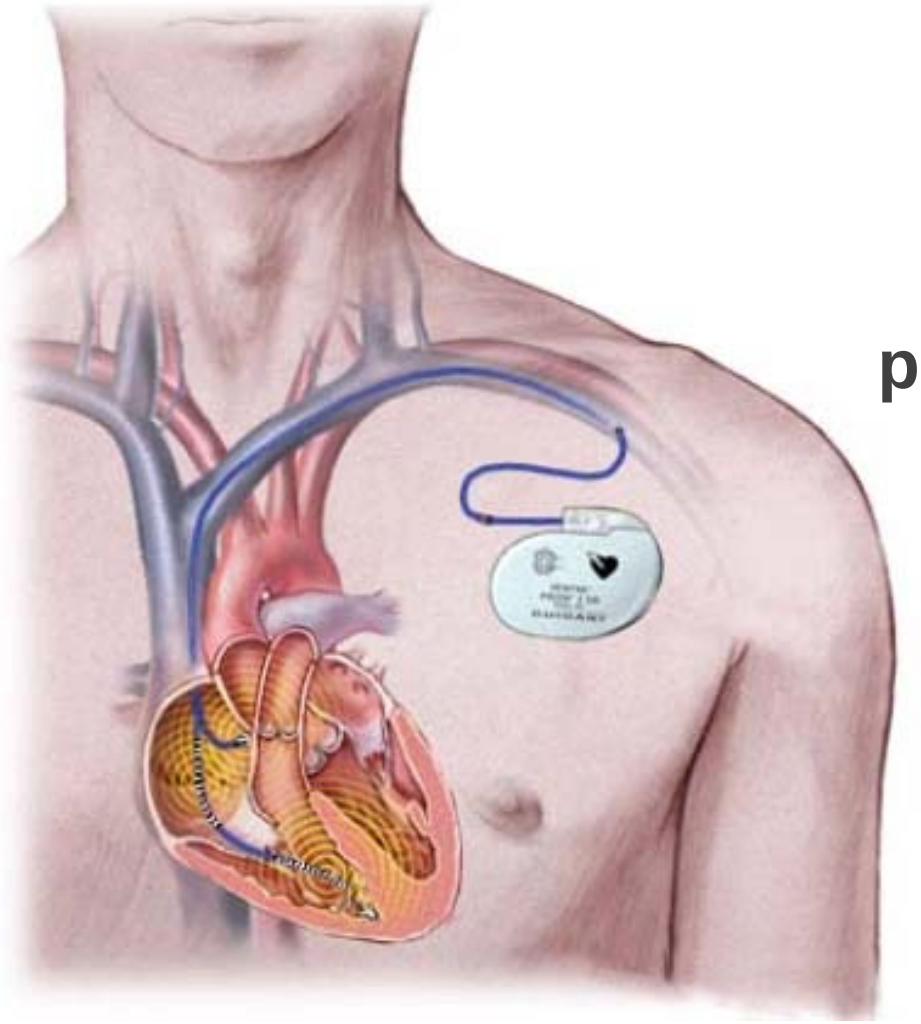


Tachycardia Detection

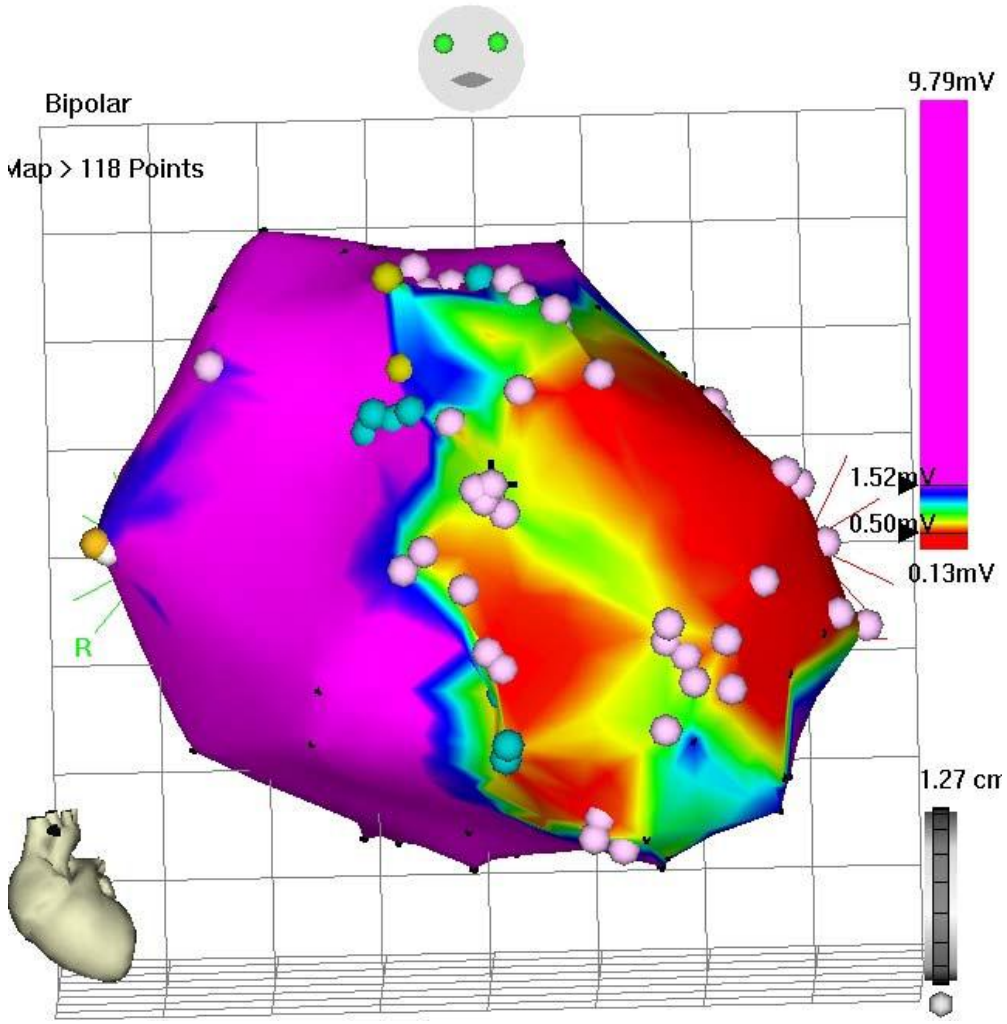


Bänsch D et al. Circulation. 2004 Aug 31;110(9):1022-9.

Ventrikuläre Tachykardie



plus



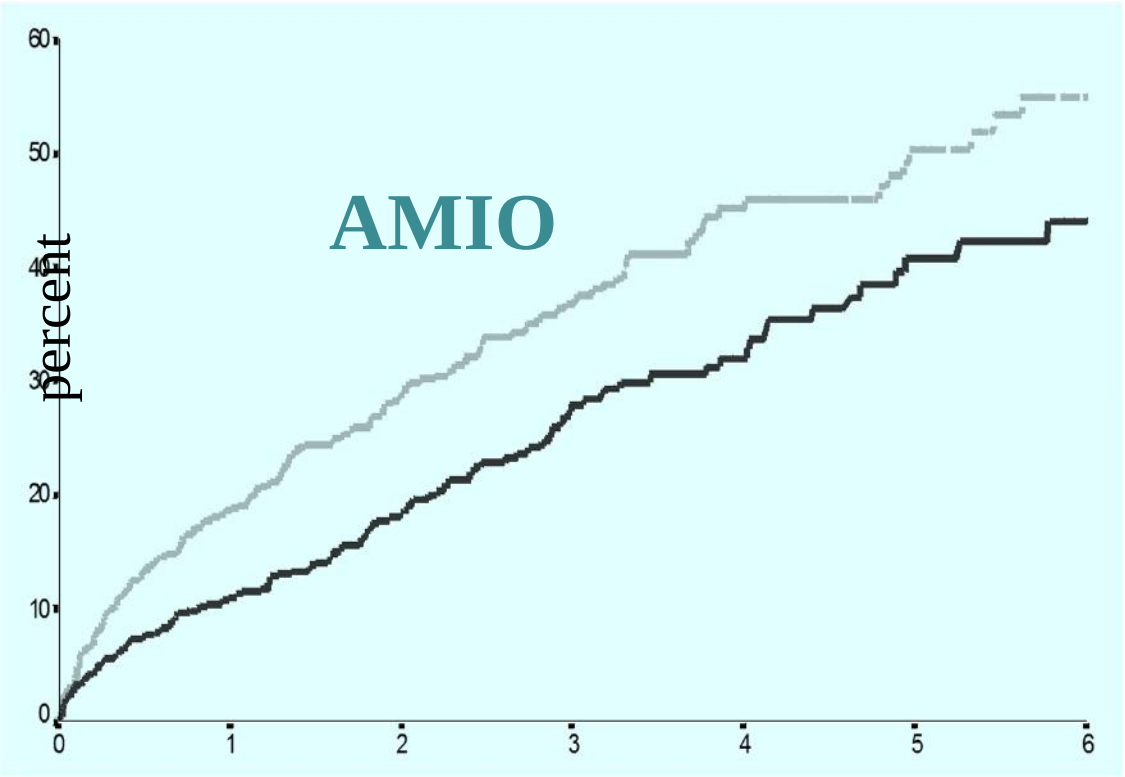
Prevention of Sudden Cardiac Death

Trials behind ICD guidelines that favour ICD therapy

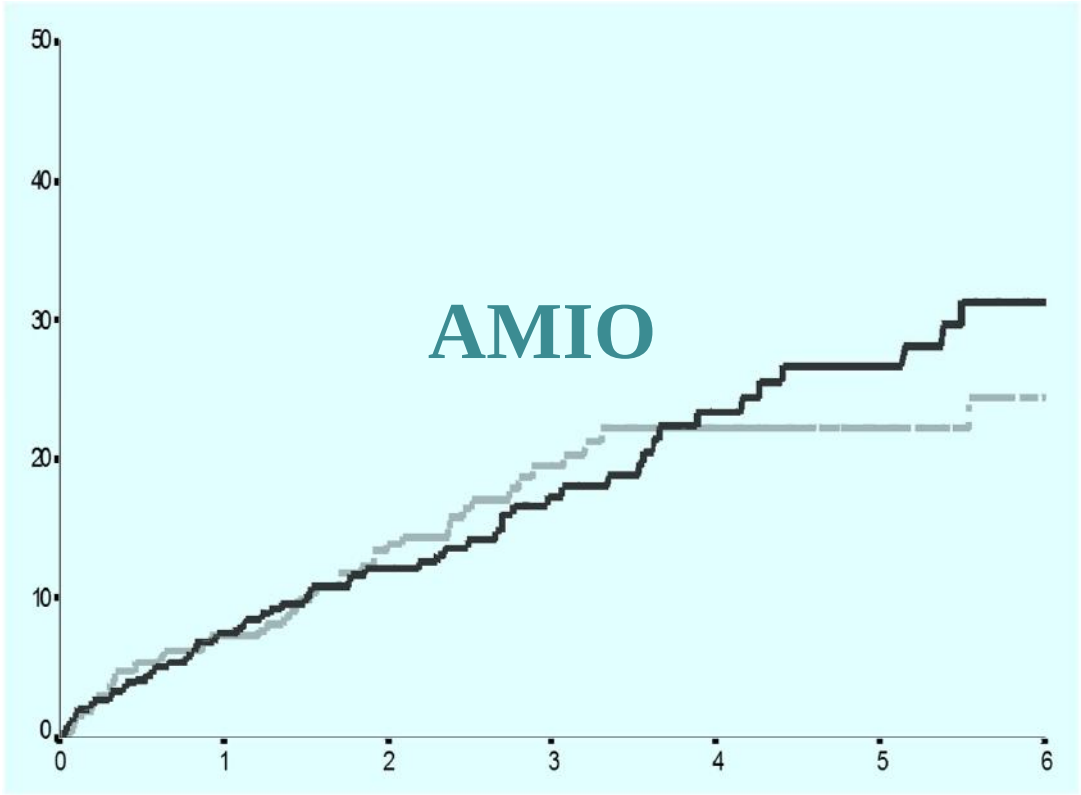
Study	Publication	Recruitement
MADIT I	1996	1990-1996
AVID	**1997**	**1993-1997**
CIDS	**2000**	**1990-1997**
CASH	**2002**	**1987-1998**
MADIT II	2002	1997-2002
COMPANION	2002	2001-2003
SCD HeFT	2005	1997-2001

Cumulative Risk of Death in AVID CIDS and CASH

LVEF ≤ 35%



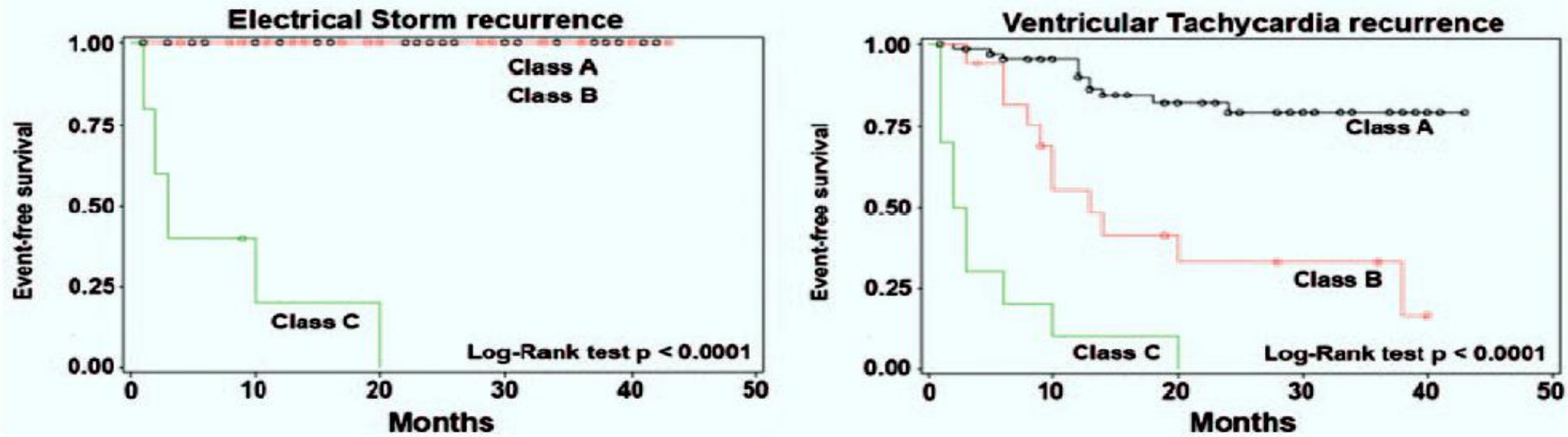
LVEF > 35%



years

VT Ablation

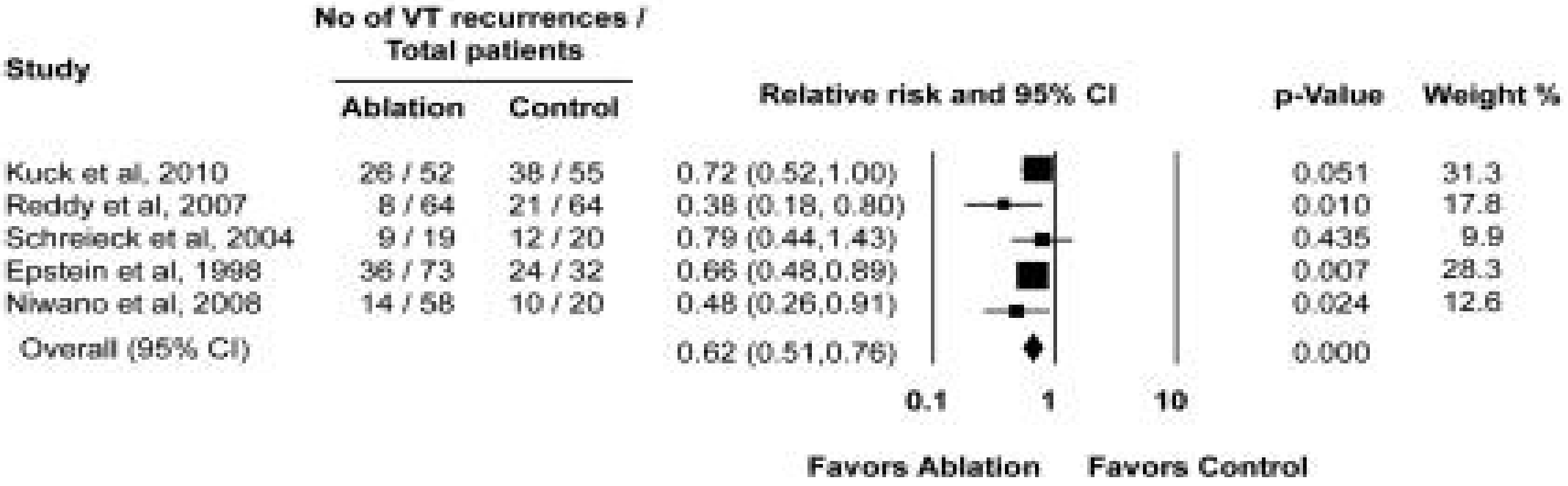
Endpoint and Prognosis



Carbucicchio, C et al. Catheter Ablation for the Treatment of Electrical Storm. Circ. 2008;117;462-469.

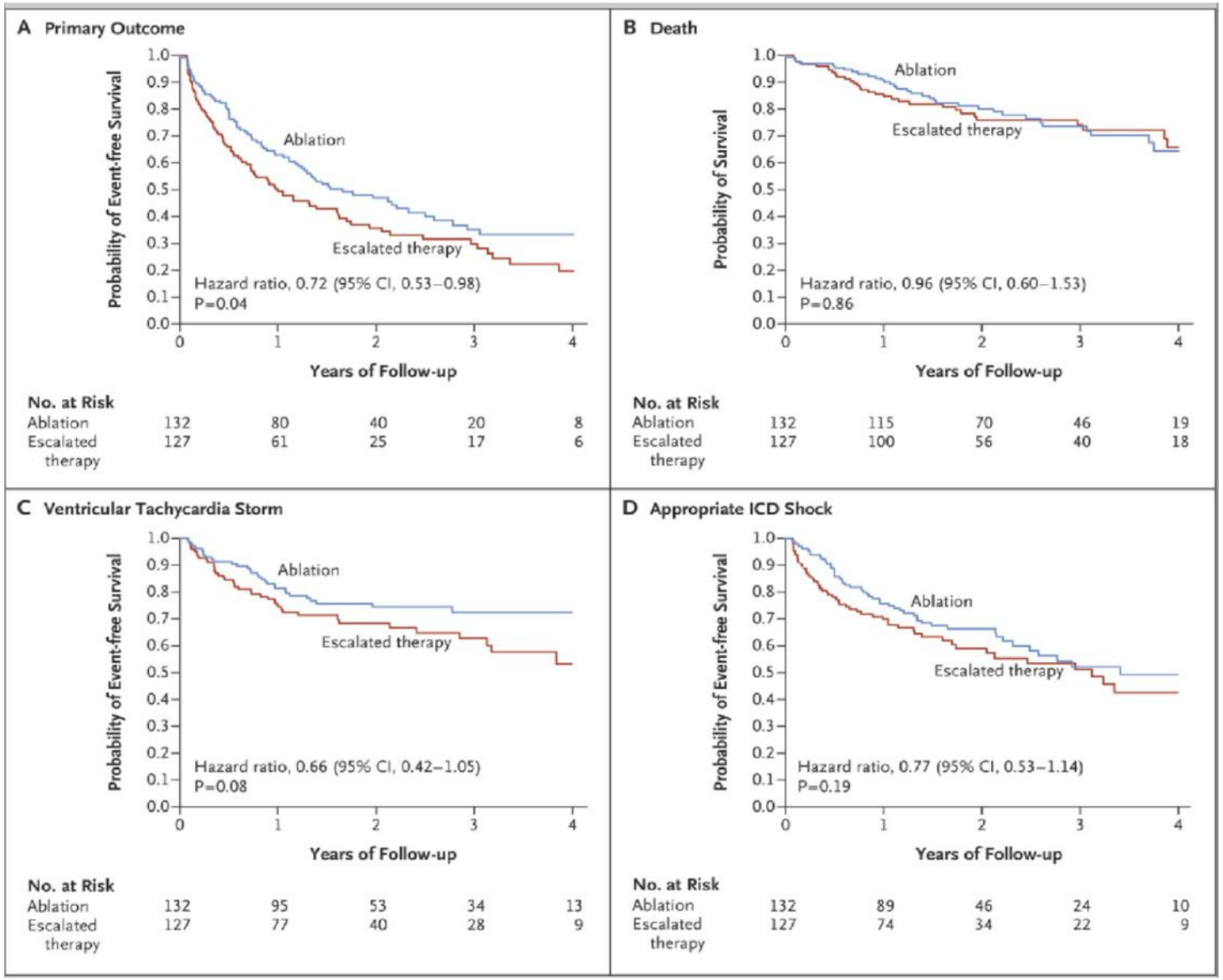
Benefit of VT-Ablation

VT-Recurrence



Mallid J et al. HR 2012

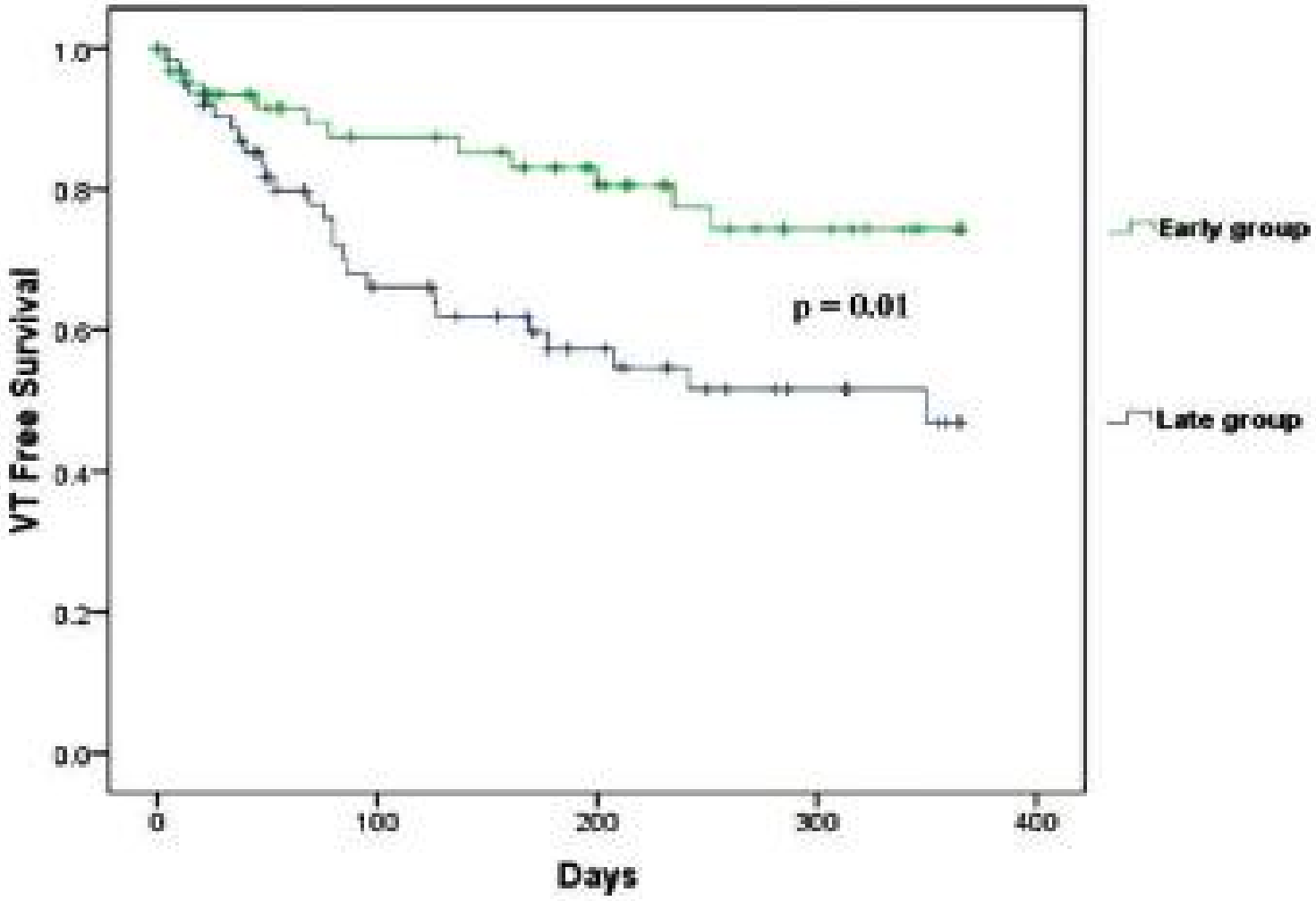
VT-Ablation vs. Amiodaron



Sapp JL NEJM 2016.

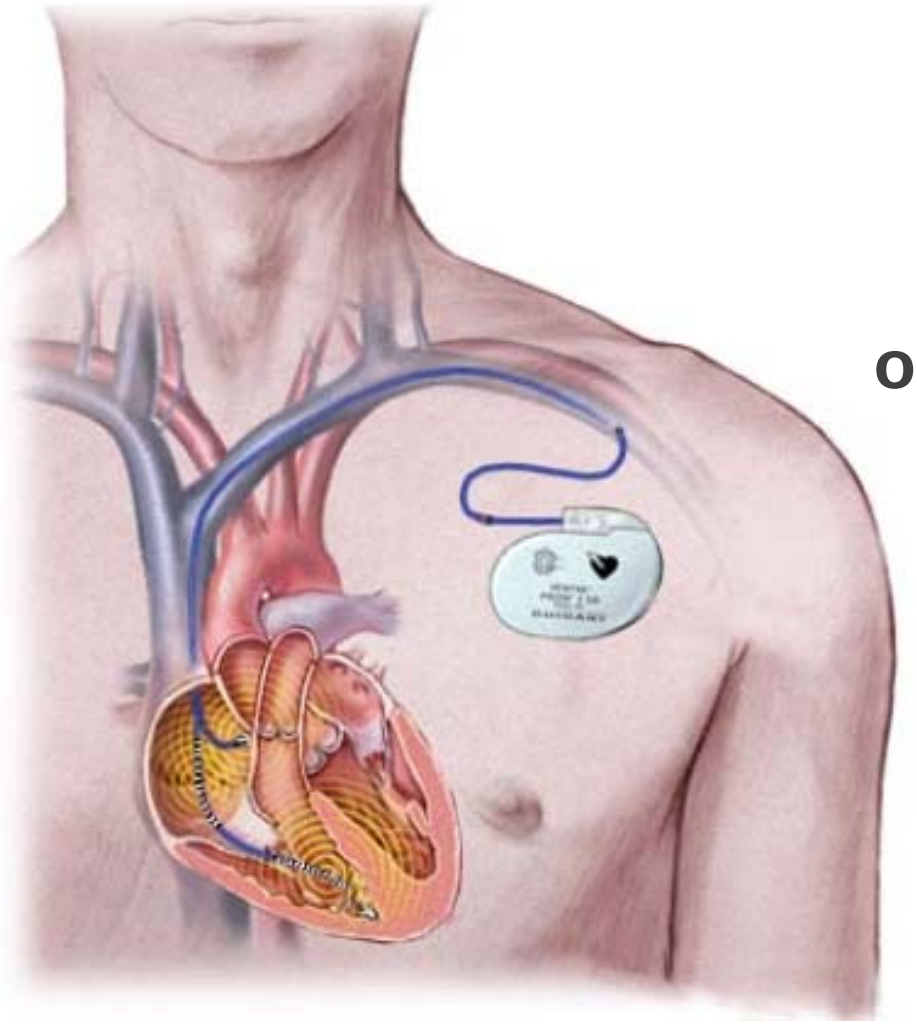
Early vs. Late VT-Ablation

VT Free Survival



Frankel DS et al. J Cardiovasc Electrophysiol, 22; 2011:1123-1128.

Ventrikuläre Tachykardie



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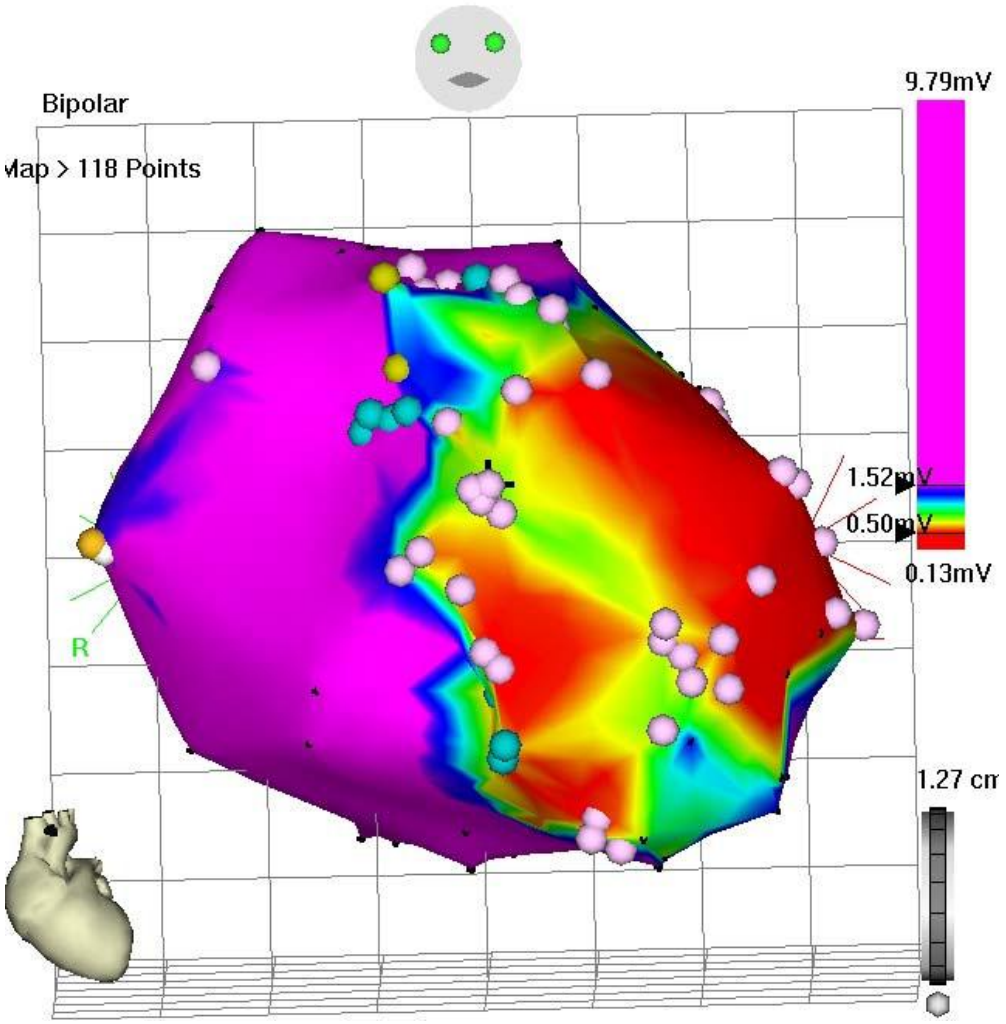
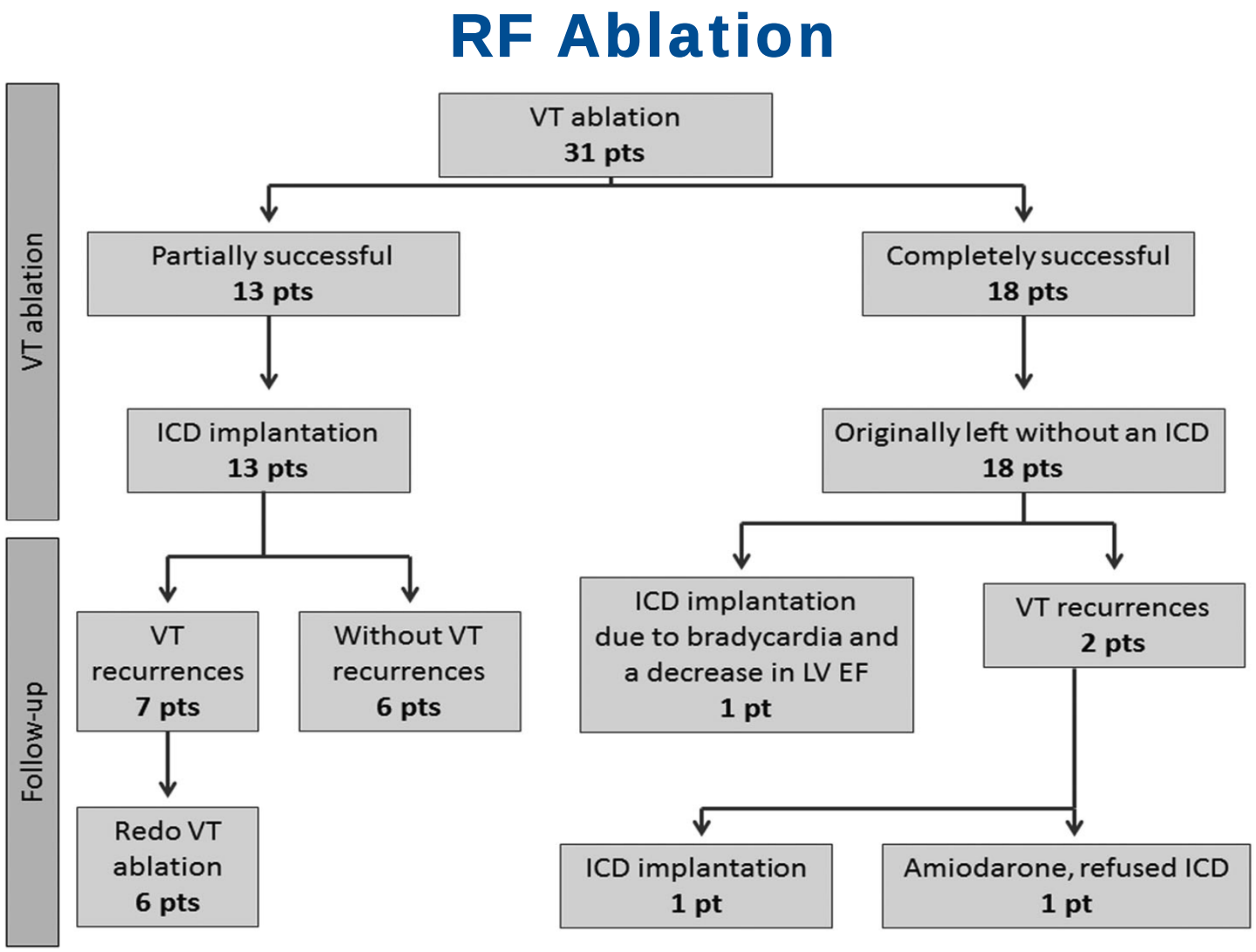


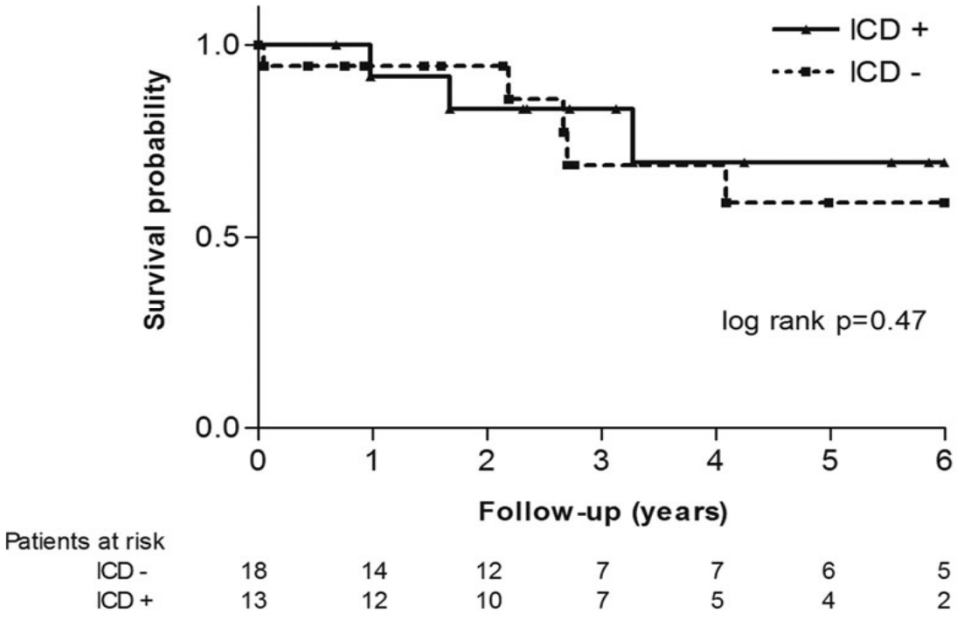
Sustained monomorphic VT

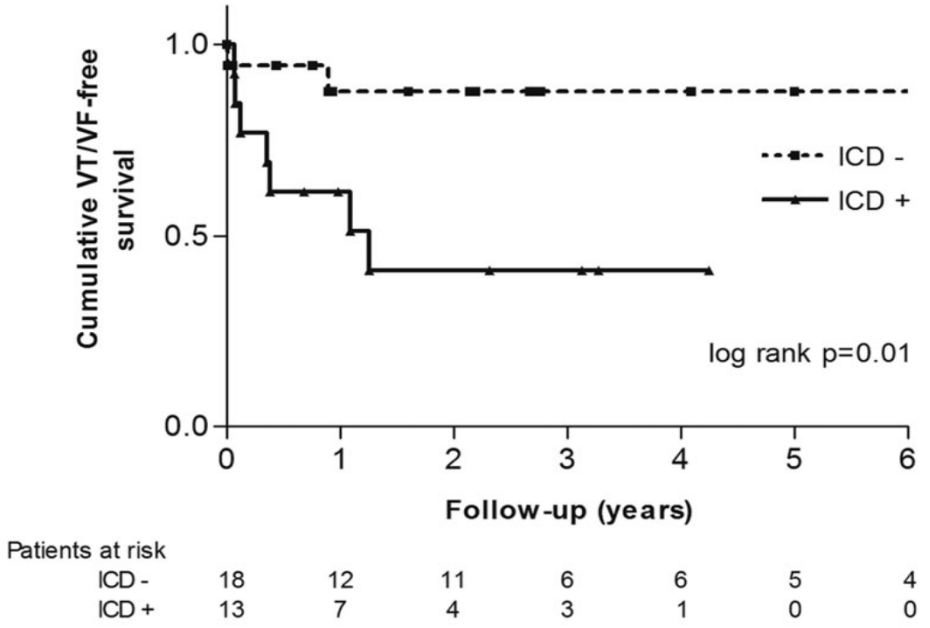


Clemens M et al. JCE 2015

Sustained monomorphic VT and VF

RF Ablation

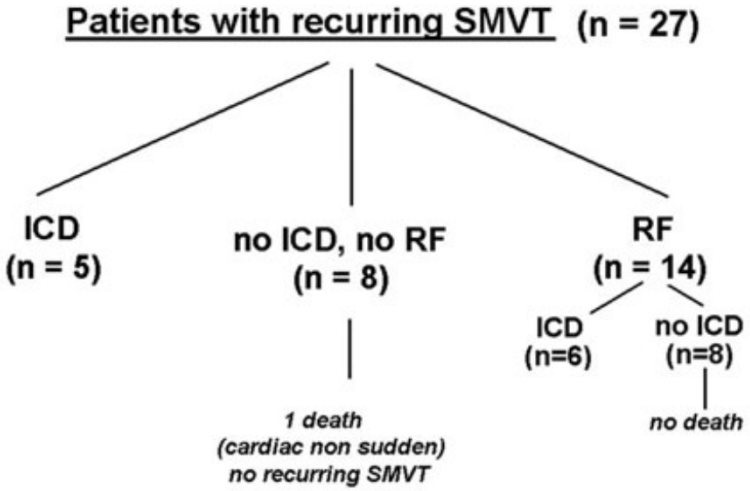


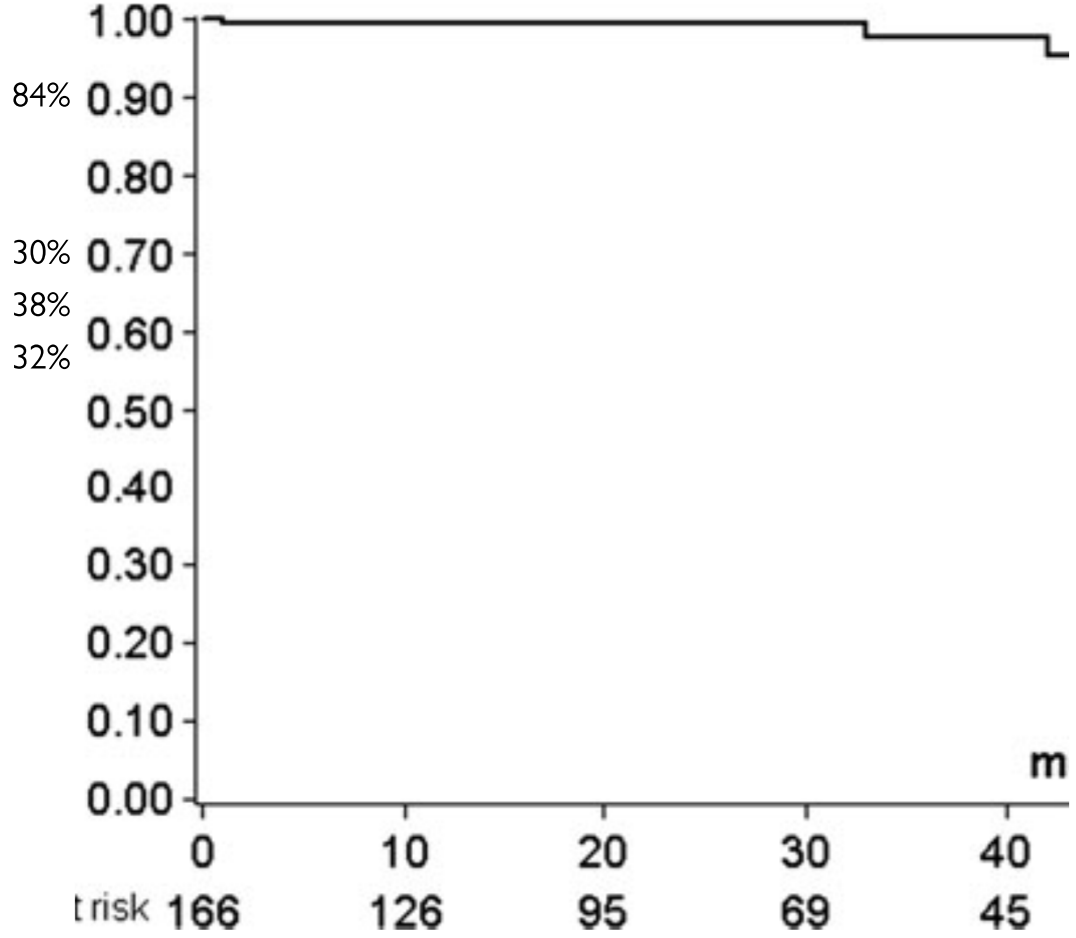


Clemens M et al. JCE 2015

Primary VT-Ablation in stable VT

Male gender	139 patients	84%
Age (years)	62 ± 15 (17–89)	
LVEF (%)	50 ± 10 (31–73)	
LVEF >30 and <45%	50 patients	30%
LVEF ≥45 and <55%	63 patients	38%
LVEF ≥55%	53 patients	32%

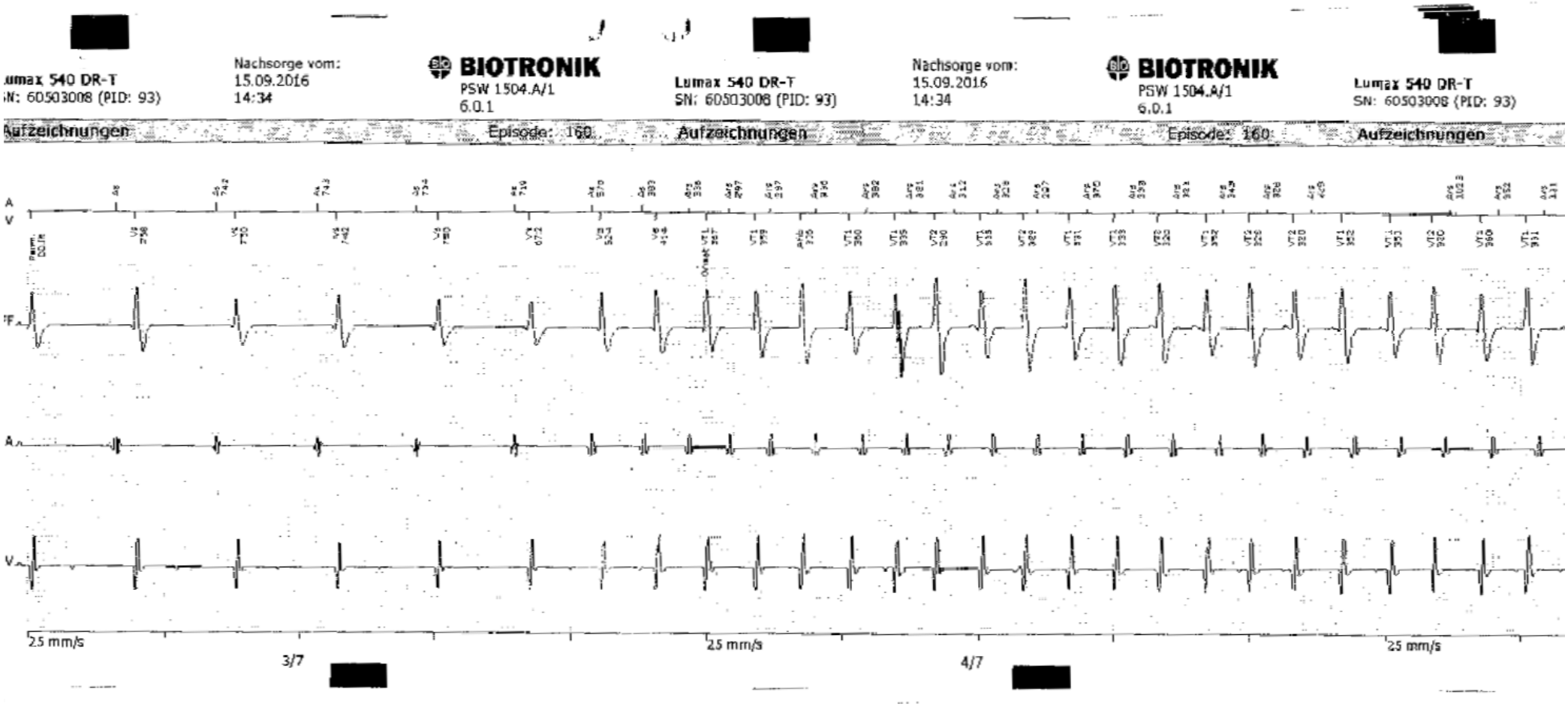




Maury P al. European Heart 2016

Anamnese

- 57-jähriger Patient, DCM, EF mittel- bis hochgradig eingeschränkt
- Z.n. CCM-Implantation 2012
- Z.n. ICD-Implantation 2011
- Adipositas, art. HT, Diabetes mellitus II
- Aktuell: ICD-Kontrolle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Aufzeichnungen
Episode: 160
Lumax 540 DR-T
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Aufzeichnungen
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25 mm/s
3/7
4/7
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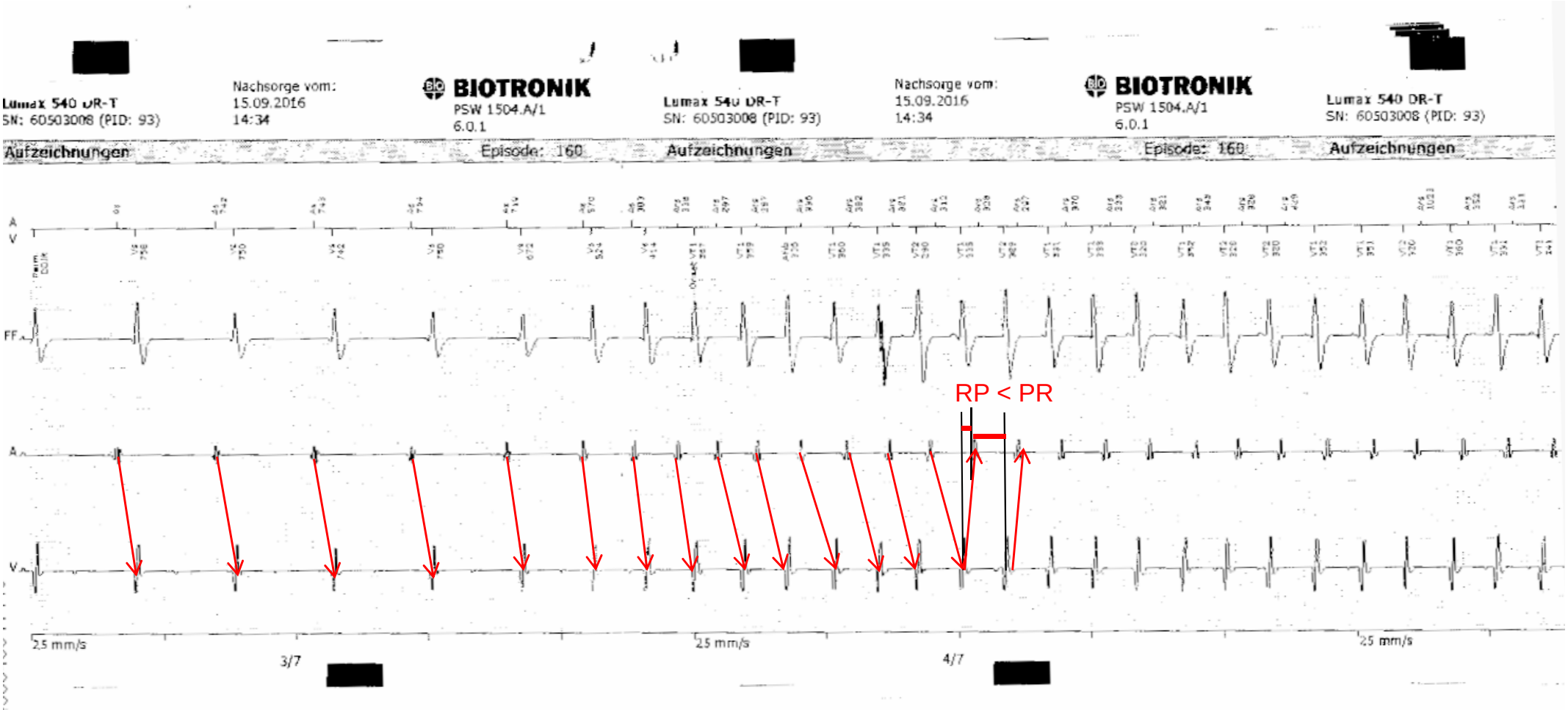
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25 mm/s
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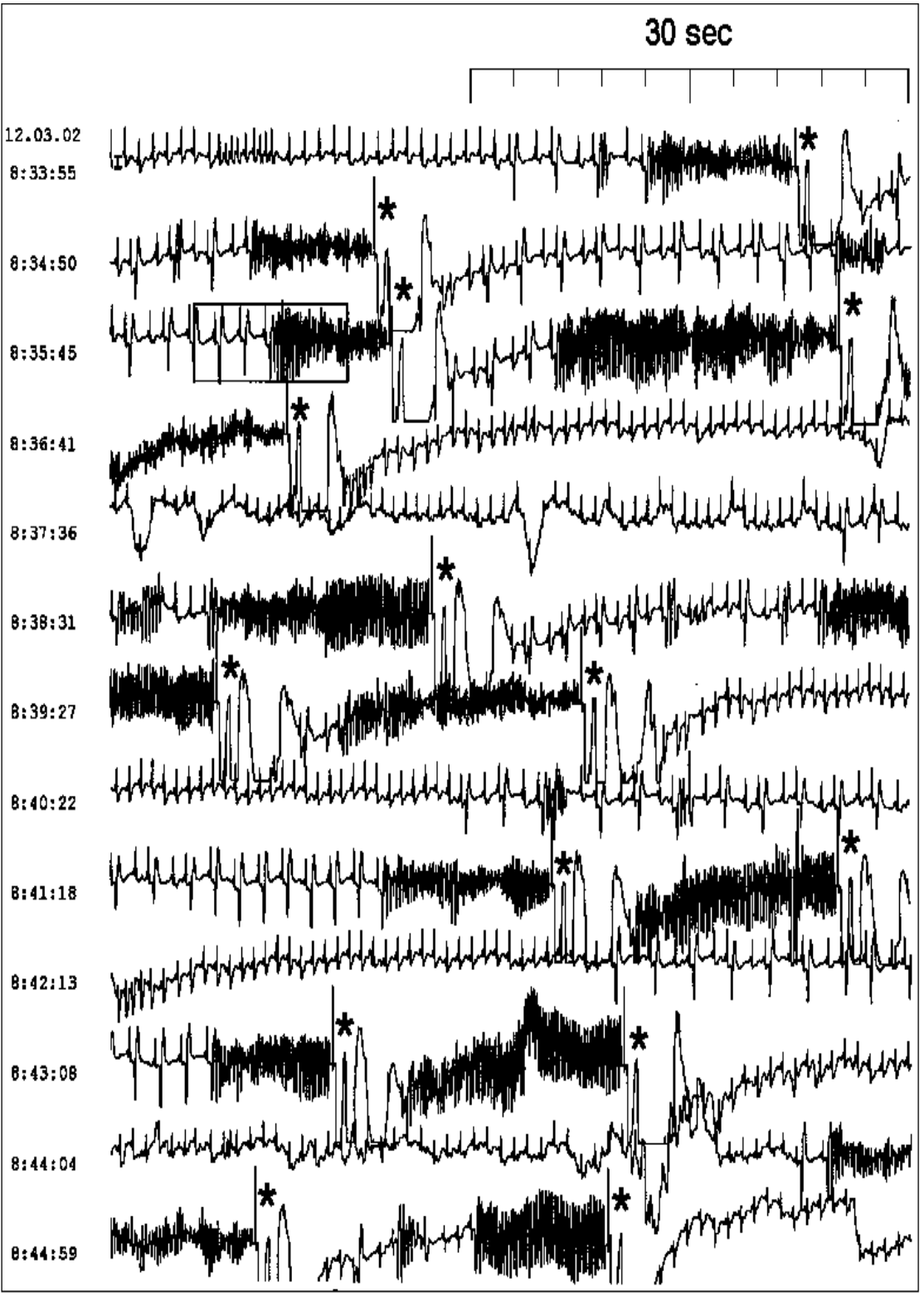
VES/Ventrikuläre Tachykardie mit struktureller Herzerkrankung

Prozedurvorbereitung

- Transthorakales Echo (LV-Thrombus)
- Amiodaron und Betablocker weitergeben
- TEE bei Vorhofflimmern
- Bei seltenen VES 12-Kanal-EKG mit EP-Elektroden
- Koro (?)


30 sec
12.03.02
8:33:55
8:34:50
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8:36:41
8:37:36
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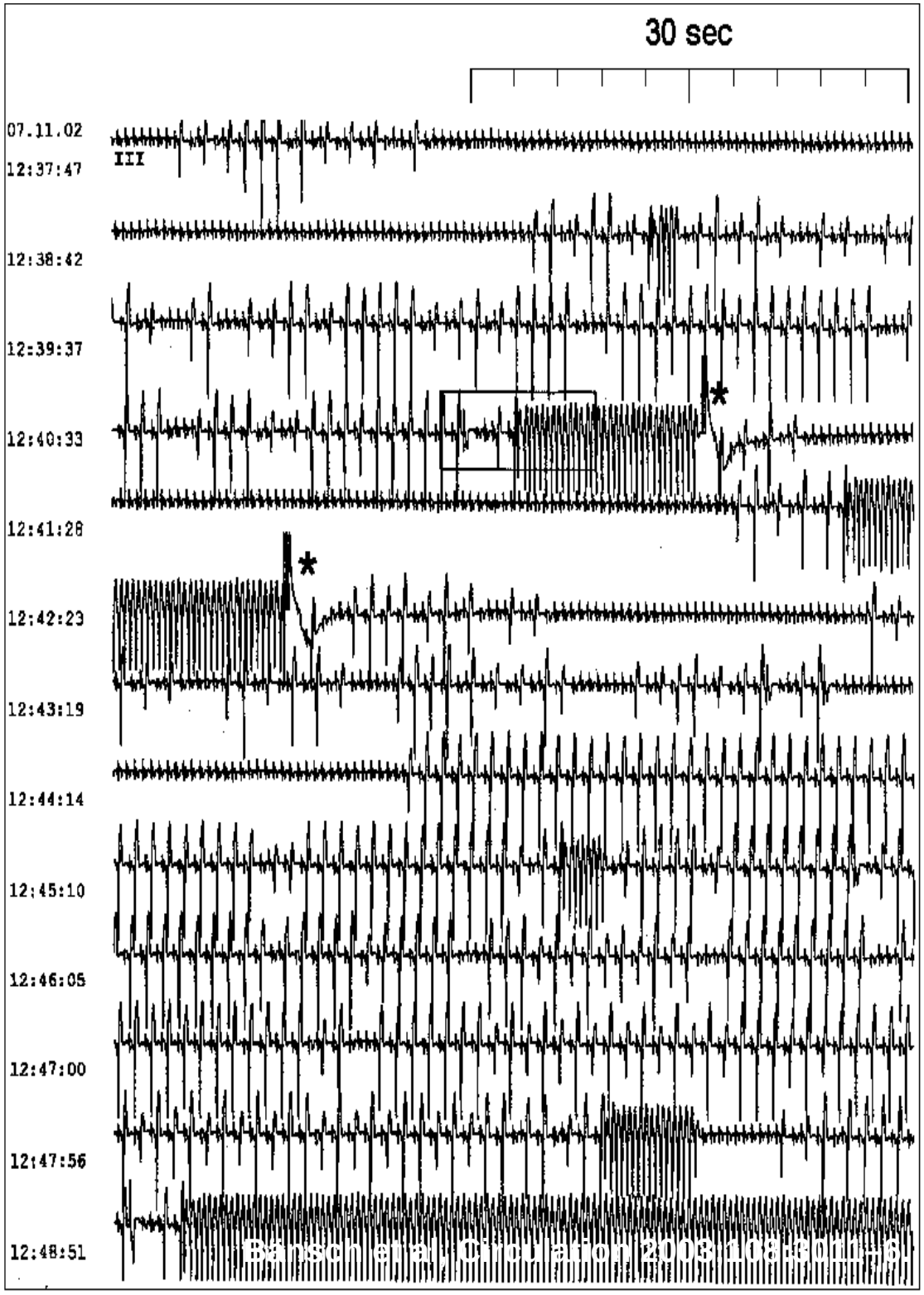
8:44:59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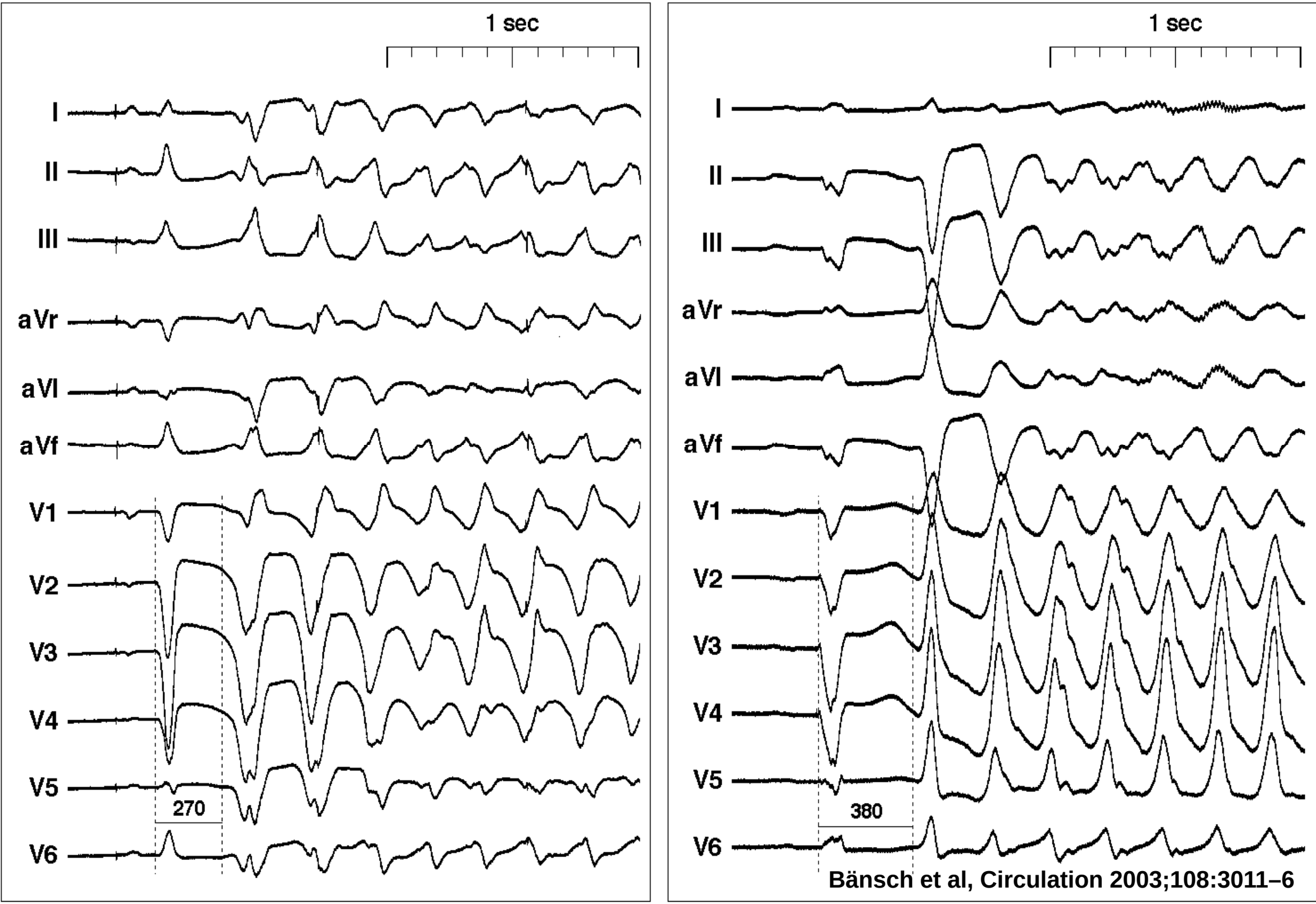
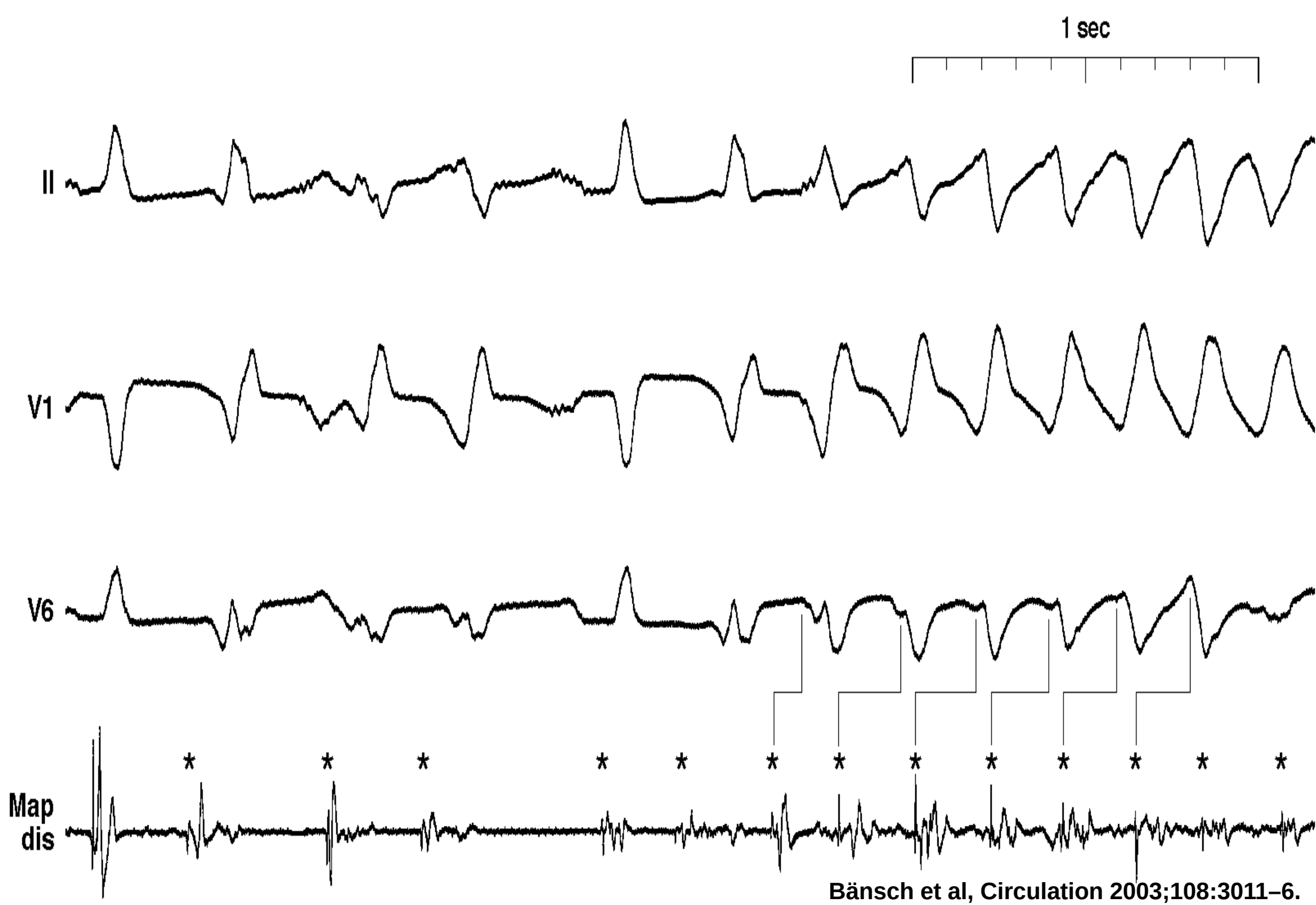
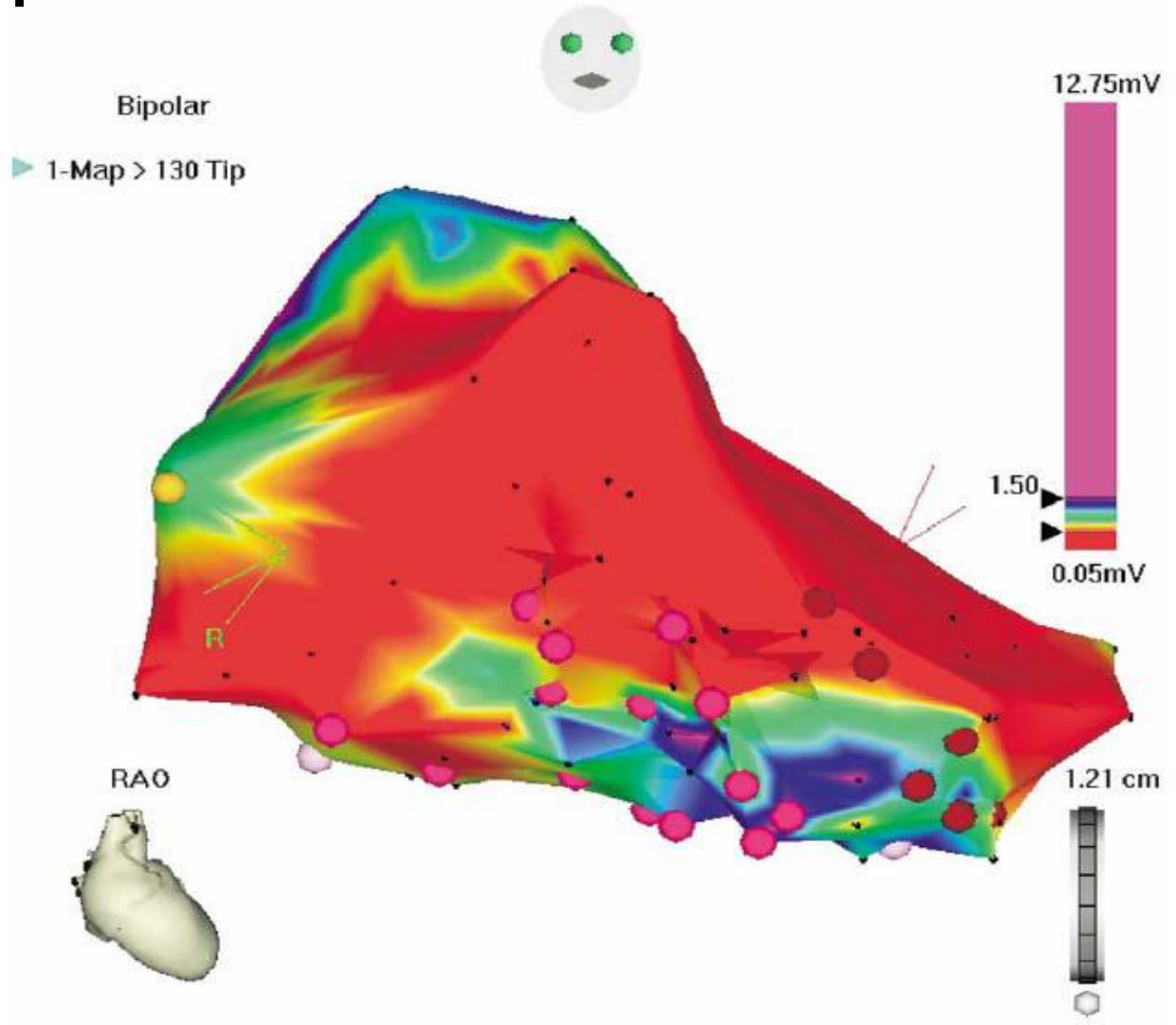


Bänsch et al, Circulation 2003;108:3011–6



Bänsch et al, Circulation 2003;108:3011–6.

Polymorphic VT after MI



Szumowski et al. JACC 2004;44:1700–1706.

Polymorphe VT
bei struktureller Herzerkrankung

Prozedurvorbereitung

- Transthorakales Echo (LV-Thrombus)
- Amiodaron und Betablocker weitergeben
- TEE bei Vorhofflimmern
- Bei seltenen VES 12-Kanal-EKG mit EP-Elektroden
- Koro
- Sedierung und Anxiolyse

Vielen Dank für Ihr Interesse

Kontakt:

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+49 38 43 – 34 14 35